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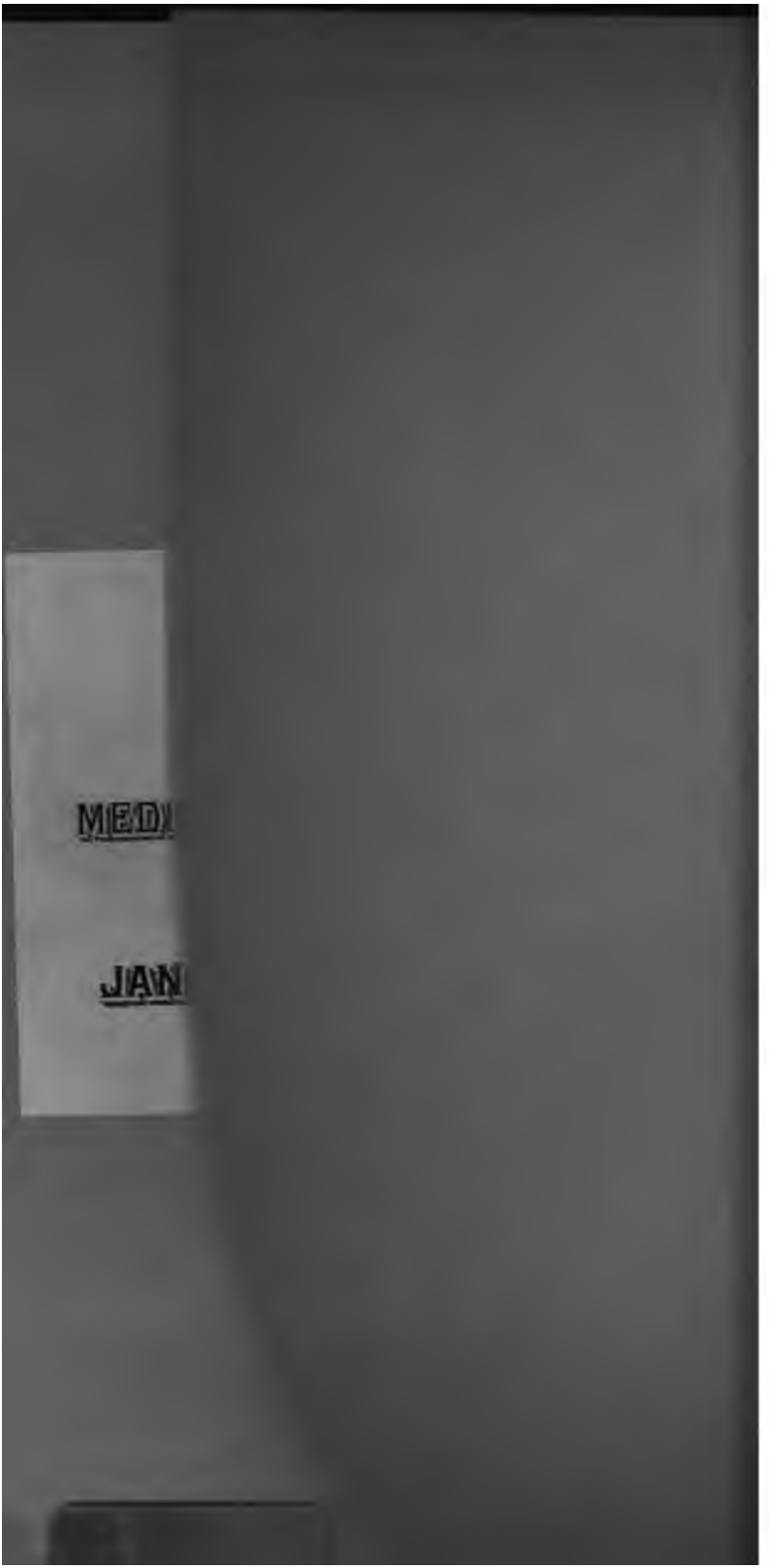
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responsible for the increased number of pages. The illustrations have been carefully revised; numbers of old blocks have been removed, and the new ones substituted will, it is hoped, prove acceptable. In this direction we must thank Mr. S. A. Sewell for his willing and intelligent co-operation. The arduous task of revising the Index has again been undertaken by Mr. T. P. Legg, Senior Surgical Registrar to King's College Hospital.

Finally, hearty thanks must be accorded to our publishers for their unfailing courtesy and for many valuable suggestions during the passage of the book through the press.

ALBERT CARLESS.

August, 1905.

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which may serve to unite the bacterial cell loosely with its neighbours. When such capsules become very prominent, large numbers of bacteria may become embedded in a gelatinous mass, known as a *zooglœa*. Capsule-formation is of some importance in diagnosis; the pneumococcus, for example, possesses a well-marked capsule when it occurs in blood or morbid exudates, and may thereby be distinguished from many organisms otherwise resembling it.

The **Methods of Reproduction** which occur among the bacteria are extremely simple, nothing akin to sexual processes having been observed. In *simple fission* the cell becomes divided into two by a thin membrane, and these two portions develop into mature organisms. In many cases the two bacteria thus produced become entirely separated from one another; but in some species they remain more or less connected by means of the capsules described above, and in this way the individual bacteria become united into groups, which are more or less characteristic of the species. This process of division may take place with great rapidity, so that a suitable material which has become infected with one or two bacteria may contain vast numbers in the course of a few hours.

Spore-formation is a more complicated process, and is found only in certain of the rod-shaped bacteria or bacilli. Bacterial spores are round or oval in shape, and are formed within the bacterial cell (endospores). They consist of a thick cell-wall filled with protoplasm, which contains less water than the mature bacterium, and has, therefore, a highly refractile appearance when seen under the microscope. The shape and size of the spores have much diagnostic value; thus, the bacillus of tetanus has an almost spherical spore, which is distinctly larger than the diameter of the rod in which it is formed, whilst the spore of the anthrax bacillus is oval, and little or no broader than the rod itself. The position of the spore is also of importance. The spores of the tetanus bacillus are at the extreme end of the bacillus, giving it the appearance of a drumstick, whilst those of anthrax are central. Spores are to be regarded as resting forms adapted to maintain the life of the species under adverse conditions, and in this respect are analogous to the seeds of the higher plants. They resist drying to a far greater extent than do the bacteria themselves. Anthrax spores have been preserved in the laboratory for twenty years without loss of viability or virulence, whilst asporogenous anthrax dies in a few weeks when dried. They are also very resistant to heat. Most bacteria (when moist) are killed when exposed to a temperature of 60° C. for half an hour, whereas many spores are not killed by prolonged boiling. Lastly, they are very difficult to kill by means of antiseptics. Anthrax spores can be killed by immersion in 1 in 20 carbolic lotion, but only after several days. Of the bacilli of chief interest to the surgeon the *B. tetani*, *B. anthracis*, *B. œdematis maligni* form spores, whilst those of glanders, tubercle, diphtheria, typhoid fever, leprosy, influenza, and soft sore are asporogenous.

Flagella are delicate filamentous extensions of the protoplasm,

planes of space, so that when sufficiently long they form corkscrew like spirals. Short forms also occur, and these are sometime designated *vibrios*, the term 'spirilla' being then reserved for th long spiral forms. The spirilla are not of much surgical importanc the only well-known pathogenic varieties being the *V. choleræ Asiatic* and the spirillum of relapsing fever (Plate I., Fig. 4).

In regard to their physiology, bacteria resemble the other plan devoid of chlorophyll in being unable to form proteid from simp materials in presence of sunlight, and have to be supplied wit ready-formed organic nitrogen from animal or vegetable source Regarded from this standpoint, they may be divided into two class —the *parasites*, which can obtain their pabulum only from the livin animal (or plant), and the *saprophytes*, which are unable to do so, an flourish only in dead materials. The leprosy bacillus may be take as an example of a strict parasite, since, as far as is known at presen it grows only in the living tissues, and cannot be cultivated outsi the body. The term *facultative saprophyte* is applied to those organisn which prefer a parasitic existence, but which will grow under sui able conditions in dead materials. The gonococcus is a good exampl it multiplies readily enough in the living mucous membrane, b grows only feebly on dead culture media. *Facultative parasites*, on t other hand, are organisms which grow best in dead materials, b which have the power of adapting themselves to a parasitic existenc It must be understood that the terms 'parasitic' and 'pathogeni are not quite synonymous. A *pathogenic* organism is one that has t power of producing disease, and it may do so without entering t living tissues at all, as when putrefactive organisms gain access a blood-clot in the uterus and cause sapræmia. A parasitic organis is not necessarily pathogenic, especially in the lower animals, sin these frequently harbour blood-parasites without appearing to suff therefrom in any way.

In addition to combined nitrogen, all bacteria require water, certa salts, and a suitable temperature for their growth. The necessi for water must be borne in mind in surgical practice, and eve attempt must be made (by accurate co-aptation of parts, drainag etc.) to prevent the accumulation of putrescible material in woun or body-cavities. This is well seen in dealing with the peritoneu the absorptive power of which is one of the chief natural defenc against peritonitis. In laboratory experiments we find that lar amounts of fluid cultures of pathogenic bacteria can be injected in the peritoneal cavity of animals without injury; the fluid is rapid absorbed and bacterial growth ceases. If, however, the peritoneu is injured so that absorption is checked, the bacteria continue grow, and fatal peritonitis results.

The requirements of different bacteria as to temperature va enormously. The majority of those of importance in human path logy grow best at or about the body temperature (37° C.), but ma forms, especially those which are commonly met with as saprophyt outside the body (such as *Staphylococcus pyogenes* and *B. coli*), gro

destroyed by heat, peptic digestion, etc., and when kept in a state of solution gradually become inert.

Toxins are divided into two distinct classes: (*a*) Certain organisms of which the most important are the bacilli of tetanus and diphtheria produce soluble *extracellular* toxins which accumulate in the fluid in which they are grown. (*b*) In the case of many other organisms, all attempts to produce a powerful soluble toxin have failed, and the specific poison appears to remain locked up in the bodies of the bacteria, and is only given off under conditions which we are unable to reproduce experimentally. These are known as *intracellular* toxins. For example, the soluble products secreted by the tubercle bacillus have but little toxic action, whereas the washed bodies of the bacilli themselves are extremely poisonous.

The pathological effects of these toxins are highly diverse, but in nearly all cases they include the production of fever. Some are selective in their action, affecting only a certain class of cell—*e.g.*, the cells of the central nervous system in the case of tetanus. Others such as those of the pyogenic bacteria, affect any tissues they may happen to reach. Under natural conditions the results of their presence in the body vary according to the amount of toxin produced, and to the susceptibility of the animal and of the tissues in question. Thus a very powerful toxin may immediately destroy the vitality of a part, leading to gangrene, whilst one that is somewhat less intense in its action may kill the tissues *en masse*, but only after leading to an acute inflammation, thereby inducing one form of coagulation-necrosis. A similar but still slower process leads to caseation; in this fatty degeneration has time to supervene in the affected tissues before their death. In another group of cases the acute inflammation may terminate in a slower but progressive molecular death of the tissues, a cell at a time, leading to suppuration. Finally, if a very feeble toxin acts for prolonged periods it may serve as a stimulant to growth and lead to proliferation of the fibrous tissues, etc., without the development of any external signs of inflammation.

Distribution.—Bacteria are very widely distributed in nature. Their presence in *the air* varies greatly with circumstances. They are absent from the pure air of mountain-tops or the mid-ocean, and present in vast numbers in cities, especially in houses. They are not given off from the surface of liquids containing them, and only remain in suspension in the atmosphere when adherent to particles of dust or moisture. They are more plentiful in dry weather than in wet, and more abundant in occupied houses than in the open air. When the atmosphere of an enclosed space is kept at rest, the dust gradually sinks to the bottom and the air becomes absolutely sterile. It has been found that the air of schoolrooms contains far fewer bacteria when the scholars are sitting quietly than when they are allowed to move about—a fact which should be borne in mind by the spectator at a surgical operation. Expired air is sterile, but in speaking and coughing vast numbers of minute particles of fluid are ejected, and

of the material is spread on a clean slide or cover-glass, allowed to dry, and fixed by being passed two or three times through the flame. This film is then submitted to the staining process, of which there are three chief varieties :

(*a*) *Simple stains*, such as carbol-fuchsin, carbol-thionin, methylene blue, etc., affect all bacteria, as well as the cells, nuclei, etc., of the morbid material. They enable the presence of the bacteria to be recognised, and their shape, size, etc., to be determined. The other two methods are differential stains, and of great importance in the recognition of the species of bacteria present.

(*b*) *Gram's Method.*—The film is immersed for three to five minutes in a stain consisting of 10 parts of a saturated alcoholic solution of gentian violet diluted with 90 parts of 1 in 20 carbolic acid in water. It is then trea ted for two or three minutes with a watery solution of iodine in iodide of potassium (iodine 1, KI 2, water 300), and finally washed in alcohol until no more colour is dissolved out. Some bacteria remain stained when treated in this way, whilst others are completely decolorized.

The following are stained : Staphylococci, *Streptococcus pyogenes*, the pneumococcus, the *Micrococcus tetragenes*, the bacilli of tetanus, anthrax, tubercle, leprosy, diphtheria, and the streptothrices causing actinomycosis.

The following are unstained : The gonococcus, the meningococcus, the *Micrococcus Melitensis*, the *B. coli*, the bacilli of glanders, typhoid fever, influenza, and soft sore, the *B. pyocyaneus*, the vibrio of cholera, and the spirillum of relapsing fever.

(*c*) *The Ziehl-Nielsen Method.*—The film is stained by means of a powerful stain, usually carbol-fuchsin, which is either heated or allowed to act for several hours. It is then immersed in 20 to 25 per cent. sulphuric acid for five or ten minutes. This removes the stain from all cells, etc., and from the majority of bacteria. A few, however, retain it, and these are called *acid-fast.* Films may also be stained in the same way and subsequently decolorized in alcohol, and organisms which retain the stain are called *alcohol-fast.* Of the organisms which are of importance in human pathology, the bacilli of tubercle and leprosy and a bacillus frequently found in smegma are acid-fast, and the two former are also alcohol-fast. Certain streptothrices are also acid-fast.

(2) It is usually necessary to supplement microscopical examination by *cultural methods* in which a suitable culture medium is inoculated with the material to be examined and kept at a proper heat for the development of the bacteria suspected to be present. These culture media are very numerous, but broth, gelatin, solidified blood-serum, and agar-agar suffice for most purposes. Broth consists of a solution of the extractives of meat, peptone, and salt. It is chiefly used for making cultures for animal inoculations, and for observations on the chemical products of bacteria. Solid culture media are more useful, since many organisms form characteristic growths or colonies on the surface or in the depth of the medium.

(*b*) It must be possible to cultivate it for many generations apart from the body. This is to get rid of every trace of the substance taken from the first case of the disease in making the original culture.

(*c*) The inoculation of a suitable animal must be followed by the appearance of the specific disease.

(*d*) The organism must be found in the animal thus infected.

We do not now demand so rigid a proof of the pathogenic effects of bacteria. Thus, although the *B. lepræ* is universally admitted to be the cause of leprosy, yet it has never been cultivated, so that only the first of Koch's postulates holds. Other tests, which space forbids us to describe, such as the presence of specific agglutinins in the blood of cases of the natural disease, are now applicable.

A few other micro-organisms other than bacteria require brief mention, but they are of little surgical importance.

1. The *yeasts* or *blastomycetes* are devoid of chlorophyll, and multiply by budding, or endogenous spore-formation, in which several spores are formed in each cell. They cause many forms of fermentation—*e.g.*, the alcoholic fermentation in solutions of grape-sugar; they occasionally gain access to the urinary bladder in diabetes and, by leading to the production of irritative products of fermentation, give rise to cystitis. The hypothetical cancer parasite was regarded by some as belonging to this class; but this idea is now generally abandoned, and the only important disease attributed to the yeast-fungi is blastomycetic dermatitis. It is characterized by multiple lesions, resembling verrucous tuberculides or in some cases epitheliomata. It is extremely chronic, and good results have followed the administration of iodide of potassium.

2. The *hyphomycetes*, or filamentous fungi, are characterized by the presence of a mycelial network of long fibres, and have a method of sporulation which is more complicated than that seen in the bacteria or yeasts. The following are the more important of their pathological effects:

Thrush, due to *Oidium albicans*, an organism sometimes included in the blastomycetes, and called *Saccharomyces* or *Monilia albicans*.

Ringworm, which may be caused by *Microsporon Audouini* (the small-spored fungus), or the *Trichophyton* or large-spored fungus, of which there are several varieties. Of these the former is more common in London and Paris, but is rare in most parts of the Continent.

Favus, caused by the *Achorion Schönleinii*.

Pityriasis rubra, due to the *Microsporon furfur*.

Keratomycosis, or parasitic ulcer of the cornea, is due to fungi of the aspergillus type, and similar organisms may also affect the lungs (pneumomycosis) or the external auditory meatus (otomycosis).

The group *streptothrix* may be regarded as the lowest of the hyphomycetes, and its members possess many similarities to the bacteria. They are of importance in surgery, since their pathogenic members give rise to the group of diseases known as 'actinomycosis.' The streptothrices form long filamentous hyphæ, which are narrower

very severe, indicating a very high degree of virulence in the organism. In general, we know little or nothing of the causes which lead to increase of virulence under natural conditions. The outbreak of an epidemic of small-pox, for instance, must be due to a sudden increase in virulence of the specific organism, but the causes which lead to this are quite obscure.

Cultures of an organism of diminished virulence are said to be *attenuated;* thus vaccine is a culture of the unknown small-pox organism in an attenuated state. The artificial attenuation of pathogenic bacteria is a subject of great importance in connection with the production of immunity, and it may be laid down as a general rule that the cultivation of an organism under slightly disadvantageous conditions tends to diminish its virulence, and *vice-versâ*. For example, the anthrax bacillus grows best at 37° C., or thereabouts, and retains its virulence for long periods at this temperature, but if it is cultivated at 42° C. it becomes attenuated. Cultures thus treated constitute Pasteur's vaccine against anthrax; when injected into animals they cause transient ill-effects, but the animal becomes immune to the disease.

(3) The organism must be *pathogenic*, if infection is to occur, and by this we mean capable of producing disease in the animal in question. Thus, the inoculation of the gonococcus into the urethra of animals leads to no results, and infection does not take place. Hence two factors must be present: the organism must be virulent, and the host susceptible.

(4) Lastly, an essential feature of infection is that the toxins of the organism must act on the tissues of the host. Thus, it is quite possible, and not uncommon, for streptococci to be present in the outer layers of the skin, and the *B. diphtheriæ* in the mouth, etc., and yet for no harmful effects to arise, since either the organisms do not form toxins, or else these toxins do not reach the tissues. This is not infection, although in such cases any slight lesion or any condition leading to local or general lowering of resistance may bring it about.

A good deal of confusion has existed between the terms 'contagion' and 'infection'; and it is well to explain that by *contagious* is meant a disease which can be transmitted to a healthy person by direct contact with the infected individual, or by the direct transmission of the virus through an intermediate individual or object, *provided that the organism has not multiplied outside the body.* Syphilis is eminently contagious, either directly, from one person to another, or indirectly, as by smoking an infected pipe. Thus, contagion is merely a limited type of infection.

The terms *specific* and *non-specific* as applied to infectious diseases also require explanation. A specific disease is defined as one which is produced by a single cause—*i.e.*, a particular species of micro-organism, and by no other. Thus, tetanus is a well-marked pathological entity, always due to the *B. tetani*, and may be taken as the type of a specific infection. Suppuration, on the other hand, may be

condition being present to explain its origin. Septicæmia, pyæmia, acute tuberculosis, the second stage of syphilis, anthracæmia, and probably the exanthemata, are illustrations of general infection (see Chapters IV. and VII.).

Immunity.

Under ordinary circumstances every living animal is constantly exposed to possible sources of infection. Bacteria are present in the air we breathe, in our food, drink, etc., as well as on our skins and in our alimentary canals. It is obvious, therefore, that there is some potent natural means of resisting the attack of these organisms, and that it is only when these means break down or are insufficient that infection occurs. This power of resisting the invasion of micro-organisms is termed *immunity*, and it is the exact opposite of *susceptibility*. Further, the process of natural cure of any infective disease is brought about by the production of such a degree of immunity (whether local or general) as shall suffice to destroy the causative bacteria. It is therefore obvious that the study of immunity is of the greatest importance in connection with the prevention and cure of disease, and the more so since the most potent artificial methods of accomplishing these ends are those which imitate, or stimulate, or give free play to, these natural processes. A brilliant example of this is seen in the modern treatment of diphtheria by means of antitoxin, in which the natural cure of the disease is imitated exactly by artificial means. Unfortunately, however, the forces concerned in immunity are still very imperfectly understood, although an enormous amount of work has been devoted to their elucidation, and it is in but few cases that the practical application of our scientific knowledge has been followed by such happy results.

Natural Immunity is that which is inherent in the constitution of the animal when born, and not due to any event taking place in its life history. Thus the lower animals are all naturally immune to gonorrhœa and many other diseases which affect man, whereas man is naturally immune to many of the diseases of the lower animals. In most cases natural immunity is general throughout all the members of the species, but this is not always the case. For example, some children are absolutely immune to vaccinia, though the vast majority are susceptible. Hence racial immunity is not quite identical with natural immunity.

It must be clearly understood that there is *no absolute standard* of immunity, since the reaction of the tissues varies between the highest degree of susceptibility and the highest degree of immunity. Thus, if several animals are inoculated with equal doses of the same bacterial culture, one may show no ill effects; another may exhibit a slight amount of inflammation at the site of inoculation; a third may acquire a spreading inflammation, which may progress to suppuration or gangrene; whilst a fourth may develop a fatal general infection. Further, an animal may be highly immune to an organism

Acquired Immunity is of two kinds—active and passive.

Active immunity results from a previous attack of the disease, either natural or due to artificial inoculation, so that the individual is freed from the risk of contracting it again. Syphilis and the exanthemata are good illustrations of diseases conferring an active immunity, which, however, is not always absolute, since well-confirmed examples of second attacks, even of syphilis, have been recorded. On the other hand, it is doubtful whether tuberculosis and the pyogenic diseases are capable of producing immunity.

The following are the most important artificial methods of bestowing active immunity: (1) Inoculation of the disease as it occurs in nature. This is of course a dangerous method, since the attack is almost as severe as one acquired in the normal way. It was formerly practised as a preventive of small-pox before the introduction of vaccination. (2) Inoculation with the virus of the disease or its causal micro-organism in a mitigated state. Vaccination is the best example of this process; the lymph employed is a culture of the small-pox organism (the exact nature of which is at present not definitely known) in a state of diminished virulence. Pasteur also applied the same method in the prevention of hydrophobia (p. 127) and of anthrax in cattle, the 'vaccine' in the latter case being a living culture of anthrax bacilli mitigated by being cultivated at a high temperature. (3) Injection of dead cultures of bacteria is used in the preventive inoculation against plague (Haffkine) and against typhoid fever (Wright). The cultures are killed by heat, and small doses injected subcutaneously. The result is a local inflammatory reaction of varying severity, together with general symptoms, such as fever and malaise. When these have passed off, the patient has acquired some immunity to the disease, so that he is now able to withstand the injection of a dose of the living culture, by which means the immunity is greatly increased. Koch's new tuberculin (TR) is of a similar nature; it consists of an emulsion of finely comminuted tubercle bacilli which have been killed by a process of grinding. Repeated injections are necessary, and the dose must be gradually increased as toleration is acquired. Good results have been obtained from its use, especially in certain cases of tuberculosis of the bladder. (4) Injection of the extracellular toxins of the causative organism is not used in man, but it is of the utmost value in immunizing the lower animals for the preparation of curative sera, especially antidiphtheritic and antitetanic. The horse is chosen for this purpose, since it is easy to handle, and yields a large amount of serum at each bleeding. The principle of the method is simple. A small quantity of the toxin (which has been filtered to remove living bacteria) is injected subcutaneously. It causes local inflammation, fever, and malaise; but when these have quite subsided, another and slightly larger amount of toxin can be tolerated. In this way the dose is gradually increased, until the animal is so resistant that the injection of enormous doses of most powerful toxin will produce but slight and transient ill-effects. In actual practice this method is

its tissues, and the toxin will exert its poisonous effects, both local and remote. If we inject the same culture into an immune animal (whether the immunity is natural, active, or passive), the bacteria will be killed and the toxin will have no action. We will discuss bacterial immunity first.

Omitting theories which are merely of historical interest, we come first to the *humoral theory*, which asserted that the destruction of the bacteria was due to certain substances which are present in the blood, lymph, etc., and which were designated *alexins*. The experimental foundation for this theory consists in the fact that fresh blood, and more especially fresh blood-serum, has very considerable bactericidal action. This action is destroyed if the serum is exposed to heat (about 60° C. for half an hour), and disappears spontaneously after a day or so; when the alexins have been destroyed by either process, the serum becomes an excellent culture medium for most bacteria.

Metchnikoff's theory of phagocytosis (the *cellular theory*) was at first in strong opposition to the humoral theory, but subsequent researches have brought the two closer together. Starting from the fact that unicellular protozoa (such as the amœba) ingest, digest, and assimilate the bacteria found in water, Metchnikoff was led to examine the action of the leucocytes, or wandering cells of the higher animals, which in their morphology so strongly resemble the lower protozoa, and found in them a similar power of engulfing and digesting living micro-organisms. This process he termed *phagocytosis*. A striking example occurs in Daphnia (the fresh-water flea), an animal which is so transparent that the whole phenomenon can be followed under the microscope during life. It is affected with a disease due to the growth in its tissues of a fungus known as Monospora. The spores of this parasite are taken in with the food, and penetrate from the alimentary canal into the body cavity; when unchecked, they continue to grow until the whole animal is filled with growth. If, however, but few spores gain access, the defensive mechanism comes into play, and the spores are surrounded and engulfed by the leucocytes, submitted to a process of digestion, and finally destroyed. It is obvious that Daphnia is partially immune to Monospora, and that the immunity depends on the phagocytic activity of its leucocytes. Metchnikoff had no difficulty in finding many examples of the same process in man and the higher animals. If, for instance a culture of a non-pathogenic organism is injected into the peritoneal cavity of an animal, and portions of the peritoneal fluid are examined from time to time, the bacteria will be seen first lying free; then engulfed in the protoplasm of the leucocytes, but retaining their normal appearance and staining reactions; then less distinct and refractile than before, indicating that they have undergone partial digestion, and in this state they stain badly. Similar appearances may also be seen in sections of tuberculous tissue, especially those that are healing, though here the phagocytic cells are not leucocytes but epithelioid or giant cells.

The leucocytes are attracted to the region of the bacteria owing to

fresh field of research. It was found possible to cure the disease by a suitable serum or antitoxin which has no bactericidal effect whatever, so that its activity cannot be attributed to alexins or other bactericidal substances.

Metchnikoff explained its practical value by attributing to it the power of stimulating the leucocytes to more vigorous phagocytic action; but this view can no longer be sustained, though, as we shall see, it has a substratum of truth. Further researches showed that the action of the antitoxin is an extremely simple one. It unites with its specific toxin, and forms a compound which is devoid of toxic properties. It is unnecessary to give the full evidence on which this statement is based, but one single proof may be mentioned. Several bacteria—amongst others the tetanus bacillus—produce toxins which have the power of dissolving red blood corpuscles (hæmolysis); hence these substances are called the bacterial hæmolysins. Experiments on hæmolysis can be carried out *in vitro*, and it is thus possible to avoid all complications arising from phagocytosis or the action of the living tissues. Now it is found that tetanus antitoxin will prevent the hæmolytic action of the hæmolysin of the tetanus bacillus in the test-tube as well as in the body. Here, therefore, there must be merely a simple process of chemical neutralization, which may be compared with the action of an alkali on an acid.

The discovery of the antitoxins for diphtheria and tetanus led to numerous attempts to form similar substances for other poisons. It was found impossible to produce antitoxins for the alkaloids, mineral poisons, etc. Antitoxins were, however, prepared for snake-venom, eel-serum, abrin, ricin, etc., and for some other bacterial toxins. These poisons have these factors in common: they are all formed in living organisms, whether animal or vegetable, and they are all proteids or closely-allied substances.

The *method of action of the antitoxins* throws a certain amount of light on the mechanism of some forms of immunity. It has no bearing on natural immunity, for the blood of an animal which is naturally immune, say, to tetanus, does not contain tetanus antitoxin; but in recovery from tetanus the antitoxin appears in the blood. When this happens, any fresh toxin that the bacilli form will be immediately neutralized, and the latter will thereby be deprived of their power to injure the cells of the animal, and can be dealt with by phagocytosis or other means. In the production of passive immunity similar phenomena take place; the antitoxin artificially injected in the blood combines with the toxin and shields the cells from its action.

But this leaves the *method of formation of these antitoxins* unexplained. Several theories have been advanced to account for this phenomenon, but the only one of importance is *Ehrlich's side-chain theory*. It is somewhat complicated, but the brilliant way in which it accounts for the chief facts, and its profound influence on modern ideas of pathology, justify a brief outline of its more important features.

A toxin possesses two properties, that of poisoning a cell and that of com

Ordinary chemical poisons do not give rise to the formation of antitoxins, since they do not unite especially with the side-chains as if they were nourishing proteids, but form chemical combinations with all parts of the molecule indiscriminately.

It was soon found that substances allied to antitoxin might be obtained by the injection of proteid substances other than toxins into living animals. These are known as **antibodies**, the term being used to include precipitins, agglutinins, cytolysins, bacteriolysins, etc.

Precipitins are substances formed by the injection of proteid solutions, and have the property of forming a precipitate when mixed with a solution of the same proteid as was injected. Thus, if a solution of egg albumen is injected into a rabbit, the serum of this animal (after a week or so) will give a flocculent precipitate with egg albumen, but not with other proteids. The precipitins are not known to have any bearing on the question of immunity, except in that they form an example of the general law that if any foreign proteid is injected into a living animal it gives rise to the production of an antibody.

Agglutinins are formed by the injection of bacteria, red blood corpuscles, cells, etc., and they have the power of causing the cells injected to collect into clumps. A special case of great importance is in typhoid fever, where the agglutinin is formed early in the disease and is of diagnostic value. In most infections this is not the case. Thus in pneumonia the serum rarely shows any power to agglutinate the pneumococcus before convalescence is established. They are, however, of value in that they often enable the bacteriologist to prove the causal relationship of an organism and the disease it is supposed to produce. Thus in the investigation of the pathology of dysentery various organisms are isolated from the stools, and if one of these is found to be clumped powerfully by the patient's own serum, it affords strong proof that it is really the infective agent. The agglutinins are also useful as proving the identity of an organism which has been isolated in culture. For example, if a culture of an organism resembling the typhoid bacillus had been isolated from the stools in a case of suspected typhoid fever (or from drinking-water, etc.), the first test applied to establish its nature would be to see if it clumped with the serum of an animal which had been injected with a known culture of typhoid bacilli.

Agglutinins are antibodies to the proteids contained in the cells injected. They differ from the simple antibodies (antitoxins) in that they are formed of a complex side-chain, which contains a radicle which unites with the haptophore group of the proteid, and another radicle in which resides the 'clumping' properties. The latter can be destroyed by heat, and the agglutinin then retains its power of uniting with the cells, but does not clump them. Agglutinins are not known to play any part in the production of immunity, and their presence in the blood does not necessarily indicate that the animal is immune, though this is usually the case.

The next group of antibodies—*cytolysins* (including the *bacteriolysins*, *hæmolysins*, etc.)—are of great importance in the doctrine of immunity, and are much more complex in their structure and action than the preceding. The earliest indication of their existence was obtained by Pfeiffer, who immunized guinea-pigs to the cholera vibrio, and when the immunity was fully established injected a culture of that organism into the peritoneal cavity. Some of the peritoneal fluid was withdrawn from time to time, and the organism therein examined microscopically. They were found to undergo remarkable changes, losing their shape, becoming spherical, and finally undergoing complete solution; the whole process often taken half an hour or so. This is called *Pfeiffer's reaction*, and is specific—*i.e.*, the peritoneal fluid of an animal vaccinated against cholera has no effect on the typhoid bacillus or any organism other than the cholera vibrio or its congeners. Further research showed that the

of these may be antitoxins, which prevent the further intoxication of the animal; others are agglutinins, which are without known value to the host; lastly, there are amboceptors which link the alexin or complement of the blood to the bacteria, and bring about the solution of the latter. The animal is now immune, and when any further invasion with cholera vibrios takes place the apparatus of amboceptor and complement is ready for the defence of the animal. Further, the serum of the animal contains amboceptor, and when injected into a second animal this acquires passive immunity, provided that a suitable alexin is also present. This is one of the practical difficulties which prevent the successful application of the bacteriolytic sera in medicine. The alexin present in the serum of the immunized animal soon disappears, and although an amboceptor which is formed in the blood of one animal is always capable of being 'activated' by the complement of the same animal, it cannot necessarily be activated by the complement of other animals. This question is one which is extremely complex, and is at present not thoroughly investigated, though we can hardly hope for any further advance in serotherapy until it has been elucidated.

The rôle of the leucocytes now acquires fresh interest. We have already seen reason to believe that alexin is derived from these cells, and some hold that they are also the main source of the production of amboceptor and the other antibodies. The study of these latter substances has afforded a further insight into the function of phagocytosis. It was found (by Mennes) that leucocytes from a normal animal had no power of ingesting virulent pneumococci, but that they acquired this power when mixed with the serum of an animal which had been immunized to pneumococci. Thus we may infer that immune sera have the power of aiding the action of the leucocytes, presumably in virtue of containing an antibody which unites with the bacteria and renders them vulnerable. The antibodies which act in this way might be antitoxins, amboceptors, etc., but it is possible that they may be fundamentally different. Wright, who has investigated the subject from a clinical as well as from an experimental aspect, calls them *opsonins*, and finds that the amount which is present in the blood determines the degree of immunity to various infections. Thus, if the blood of a person who is highly susceptible to staphylococci is mixed with a culture of living staphylococci, very few of the organisms will be ingested by the leucocytes, the opsonin being deficient; if the person is resistant to the infection, the bacteria are readily taken up. Wright has also shown that by the subcutaneous injection of killed cultures of staphylococci it is possible to enhance the phagocytic activity of the patient's leucocytes when an infection has already taken place, and has applied this method of treatment in furunculosis, etc., with some success. This proceeding seems at first to be illogical; the patient is already unable to combat the staphylococci in the lesion, and it seems unreasonable to inject more. The explanation probably lies in the fact that the injection of the dead staphylococci into a

CHAPTER II.

INFLAMMATION.

'INFLAMMATION is the succession of changes which occur in a living tissue when it is injured, providing the injury is not of such a degree as to at once destroy its structure and vitality.' Such was the definition given in 1870 by Burdon Sanderson, and it is sufficiently accurate if we realize that the exciting injury usually involves the admission of a soluble chemical irritant, and in most cases of a bacterial toxin; we must also exclude from the process of inflammation the later stages of repair. Formerly inflammation was looked on by pathologists as always of a destructive and harmful nature, but at the present time bacteriological research has demonstrated that it is rather of a protective or conservative character, being Nature's means of limiting the advance of noxious micro-organisms, and of finally eliminating them from the system. Occasionally, however, the tissue reaction called into existence by bacterial invasion is so severe as to increase, rather than diminish, the risks of the patient.

The **causes** of inflammation are very varied and numerous. Most frequently it is due to the admission of bacteria, and we have already alluded (p. 15) to the conditions, local and general, which predispose an individual to such invasion, and thus render him more liable to an inflammatory attack. Apart from bacteria inflammation may be lighted up by (*a*) mechanical lesions, such as blows, sprains, tension, pressure, etc.; (*b*) burns or scalds; (*c*) toxic bodies, such as acids, alkalies, or vegetable and animal poisons; and (*d*) the electric current, either in the form of lightning, or as applied by the surgeon, or through the agency of strong currents as employed for purposes of traction or illumination. It is but fair to state that not a few authorities look on the tissue reaction caused by these non-bacterial irritants as distinct from inflammation, limiting the latter term to conditions resulting from bacterial invasion. The phenomena, however, are identical up to a certain point, and we see no advantage in the suggested dissociation.

The actual *phenomena* of inflammation are perhaps best studied in the web of a frog's foot. If this is spread out and examined under the microscope, the following evidences of normal physiological

participates in this process. It has been already mentioned th
leucocytes collect in the peri-axial layer, a phenomenon due pa
an alteration in the vessel wall, whereby it is rendered more 'st
and partly to chemotaxis (p. 19). The next change consists i
passage of the leucocytes through the vessel walls, especially
of the smaller veins and less often of the capillaries. The p
is a strictly vital one, brought about by amœboid movement; a
arm or outgrowth of the leucocyte (*pseudopodium*) is inserted be
the endothelial cells lining the vessel, whose cohesion has
probably interfered with by the inflammatory process. Int
arm the protoplasm of the leucocyte flows, still further sepa
the endothelial elements, and thus the cell passes through th
into the surrounding connective tissues (Fig. 2). The migrat

FIG. 1.

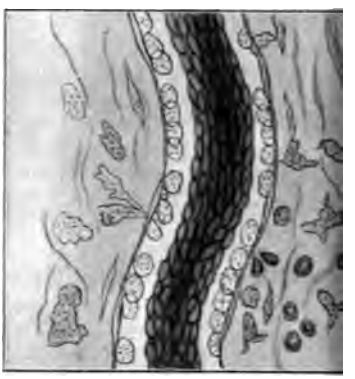


FIG. 2.

SEMI-DIAGRAMMATIC REPRESENTATION OF THE VASCULAR PHENOMEN
INFLAMMATION (AFTER THOMA).

(On the left is a normal vessel with its peripheral layer free from corpusc
its axial stream so rapid that the individual corpuscles cannot be see
the right is a similar vessel in a state of inflammation; the blood-curr
been retarded so that the individual corpuscles are visible; the leu
occupy the periphery of the vessel, and are in process of migration,
sundry red corpuscles can also be seen in the surrounding tissues.)

the leucocytes only lasts as long as the blood in the vessel is ac
circulating; as soon as thrombosis occurs, migration ceases.
the white corpuscle has escaped into the peri-vascular tissues, i
undergo various changes. In the first place, it may die a
at once disintegrated, setting free fibrin ferment, and thus ass
the production of the inflammatory coagulum to be s
described; or, again, it may find its way back into the circu
through the lymphatics, or be transformed into a pus corp
moreover, prior either to disintegration or transformation into
corpuscle, it may attack and assist in removing any dead
which exists in the neighbourhood of the inflammatory focus,

of the toxins or destroy the bacteria, these will be brought in large amounts to the region where they are required. We may regard the excessive transudation of the plasma as an additional means to fulfil the desiderata enumerated above. The value of the stasis of the blood is less obvious, and possibly it must be regarded as a necessary evil result of the action of the toxin, and not as part of the defensive reaction. It may be pointed out, however, that it probably assists the emigration of the leucocytes, which might otherwise find difficulties in attaching themselves to the walls when floating freely in a rapid blood-stream. The rôle of the leucocytes has been touched on already. Their most important duty is to serve as phagocytes and to ingest bacteria, whether the latter are normal, or acted on by opsonins, or rendered innocuous by antitoxins. Moreover, we have seen reason to regard them as the probable source of alexins or complements, whilst other authorities consider that the defensive antibodies are mainly derived from them, and have ascribed to them the power of absorbing and neutralizing toxins.

In addition, however, to these vascular phenomena, which can be readily seen in a frog's web, there are others which cannot be so easily observed, and which may be described as

II. The Tissue Changes in Inflammation.

Great differences of opinion have been in existence as to the part played by the tissues in inflammation; but although there are still many points to be elucidated, yet the general opinion of pathologists is at the present day tolerably well defined. Formerly, in accord with Virchow's cellular pathology, it was held that the tissues were the all-important element, and that the immense number of cells which collect in an inflamed area was entirely due to the proliferation of the connective-tissue corpuscles. Lister, as far back as 1858, maintained the passive condition of the tissues; and when Cohnheim, in 1867, described the migration of the leucocytes, everything in the process of inflammation was attributed to them. Since that date Senftleben and many others have worked at the same problem, and a considerable amount of fresh light has been thrown on the subject by experiments consisting in the insertion of foreign bodies into the peritoneal cavity, and by others directed towards demonstrating the phagocytic functions of leucocytes and the influence of chemotaxis. Much of the difficulty which has enshrouded the question has arisen from a confusion between the processes of inflammation and repair. At one time repair was always looked on as of an inflammatory nature; but it is now admitted that although no lesion in the body can occur without a certain amount of local reaction, yet the true process of repair is not inflammatory. Again, it is important to differentiate between the changes which occur in acute and chronic forms of inflammation, and between those met with in superficial

effusion between the individual cells may be so excessive as to separate and disintegrate them, and thus **colliquative-necrosis** may be induced, as occurs in the formation of blisters after a burn.

In chronic inflammations, on the other hand, active cell-proliferation is a most important element in the process, resulting in sclerosis and induration of the parts. This, however, mainly affects the interstitial tissues, and thereby the true structure of the organ may be impaired.

It is obvious, therefore, that the **Terminations** of acute inflammation will vary considerably, and more especially with the cause of the trouble, whether bacterial or not, with the intensity and duration of its action, and finally with the powers of resistance possessed by the tissues and the individual.

In **bacterial inflammations** (1) it is unusual for the tissues so to assert themselves as to permit of the occurrence of **resolution**, or the re-appearance of the *status quo ante;* it is, however, seen occasionally. (2) More frequently **local destruction of tissue** results, and, according to the nature of the bacteria and the tissues involved, this may be followed by (*a*) *repair*, the necrotic tissue disappearing and scar tissue taking its place; (*b*) *suppuration*, in which the affected tissues and the exudate are liquefied and transformed into pus; (*c*) *ulceration*, when the necrotic or suppurative process affects the surface; or (*d*) extensive *necrosis* or gangrene, when the toxic effects of the bacteria are able to break down the tissue resistance to such an extent that the bacteria are able to diffuse themselves widely in the part. In this connection it is interesting to note that the more highly organized and important parts are always more vulnerable than the simpler forms of connective tissue, and this in spite of the fact that the former are usually better supplied with blood. Thus, the growing end of the diaphysis in a child is a most delicately organized region, and hence is peculiarly liable to serious destructive inflammation from bacterial agents, which would do little harm if developing under similar circumstances in the subcutaneous connective tissues.

When the inflammatory attack is due to mechanical or other **non-bacterial** causes, there is frequently much effusion of fluid, and at first but little cellular exudation, whilst the process is distinctly limited and has no tendency to spread. The most common terminations are: (*a*) *Resolution*, complete and absolute, which is seen not uncommonly; (*b*) the formation of fibro-cicatricial tissue, as seen, *e.g.*, after a localized colliquative-necrosis, or in the *organization* of lymph into adhesions after a simple synovitis; (*c*) sometimes the inflammatory process *becomes chronic*, and is then characterized by sclerosis or fibroid thickening of the part, or by persistent effusion into a serous cavity.

Resolution, or the restoration of the part to its natural condition and function, can only occur when the injury has not been so severe as to destroy the vitality of the affected tissues. The phenomena are merely those of inflammation in a retrograde order—viz., an oscillatory movement first manifests itself amongst the corpuscles, and

of the tissue, and in measure varies inversely with the amount o pain. In some cases where the inflamed area is covered by a thick and firm fascia, not only is the tensive pain very considerable, bu the chief swelling may occur away from the inflamed area, *e.g.*, ove the back of the hand in a palmar abscess; where the inflammatory products escape into lax tissues, the subjective phenomena ar minimized, although the swelling may be very great. Similar illus trations of the occurrence of œdema at a distance are to be seen i inflammations of the sole of the foot, in the swelling of the eyelid when the scalp is inflamed, and of the cheek in inflammation of th dental periosteum. Swelling due to inflammation, though diminish ing post-mortem, does not entirely disappear.

Pain.—This results from the mechanical irritation of the periphera nerve terminals, both by the increased arterial tension and by th pressure of the exudation, so that it is much greater if, from th density of fascial or fibrous investments, swelling cannot readil occur, *e.g.*, in the palm of the hand, or in the eye or testicle. Possibl the exudation may also have some direct chemical action on th nerve terminals.

A marked feature of inflammatory pain is that it is always aggra vated by pressure, whether intrinsic—*i.e.*, by increasing the blood pressure—or extrinsic, from outside agencies. Thus, if an inflame finger or hand is allowed to hang down, the pain is much increased whereas elevation causes speedy relief.

The pain of *suppuration* is throbbing in character; of an inflame *mucous membrane*, scalding, burning, or gritty; of an inflamed *serou membrane*, stabbing; of inflamed *bone*, aching or boring, and ofte worse at night; of an inflamed *testicle*, sickening. When the organ of *special sense* are inflamed, there may be little real pain, but muc exaggeration of the special sense, *e.g.*, flashes of light in retinitis an noises in the ears in otitis interna.

The pain is not limited only to the inflamed part, but is sometime experienced in distant regions, either through a similarity of nerve supply or from the fact that a sensory stimulus is always *referred* b a patient to the end of the affected nerve. For example, in *hip disea* the chief pain is often felt in the knee, because the two joints have similar nervous supply. In *renal calculus* or colic, pain is referre along the course of the genito-crural nerve into the groin and fron of the thigh, and is often accompanied in the male by retraction c the testicle on the side affected. In *spinal caries* pain is frequentl experienced in the terminal branches of the nerves issuing from th part affected, *e.g.*, the so-called 'belly-ache' of dorsi-lumbar disease.

Impairment or Loss of Function is due sometimes to the mechanic difficulty of using a swollen organ, sometimes to the pain elicited b such attempts, but often to the paralyzing effect of the inflammator process, and this in infective lesions results from the direct influenc of the toxins on the protoplasm of the cells affected. Thus, a inflamed eye is from various causes of little use for vision; a muscl when inflamed, is naturally kept at rest; glandular organs, *e.g.*, th

toxins produced by the action of micro-organisms, if injected into the circulation in a pure state, possess such a power.

In regard to the symptoms of fever, it may be stated briefly that they are in large part due to the effect produced by the increased temperature or the toxic products circulating in the blood upon the constituent cells of glandular and other organs. The phenomena in question are termed by different pathologists 'acute or cloudy swelling,' 'granular degeneration,' 'albuminous infiltration,' etc., and are characterized by the organs becoming soft, friable, and more or less swollen. The secreting cells of glands are increased in size, and the protoplasm becomes markedly granular, so that the nucleus can only be distinguished with difficulty. The granules are albuminous in character, clearing up completely on the addition of acetic acid. A similar change is also evident in the fibres of the cardiac muscle, which lose their striation and become granular, a condition which must considerably interfere with their contractility. The effect produced upon the glands of the digestive system explains many of the febrile manifestations, inasmuch as their function is largely impaired. The salivary and buccal glands are unable to excrete the normal amount of saliva, and hence the mouth becomes dry. Gastric digestion is interfered with in the same way. The bile is not efficiently produced, and hence its fat-emulsifying properties are diminished, as also its cathartic powers, whilst the patient cannot properly digest fats, and is constipated.

Various terms have been applied to different *types of surgical fever*, *e.g.*, sthenic and asthenic, which sometimes depend as much upon the constitution of the patient as upon the nature or cause of the affection. By **Sthenic** inflammatory fever (Greek, σθενος, strength) is meant that condition in which pyrexia and all its accompanying symptoms are well marked. It occurs mainly in young healthy adults of sound constitution, as, for example, when a young man is suddenly attacked by acute pneumonia, or when an acute abscess is forming. **Asthenic** inflammatory fever (Greek, ἀσθένος, without strength) is characterized by the tendency to exhaustion and collapse associated therewith. It is met with in debilitated subjects and those exhausted by vicious habits, but may also occur at the close of a long period of pyrexia, *e.g.*, in the third week of typhoid fever (= the *typhoid state*). The absorption of products of putrefaction and the occurrence of acute infective blood-poisoning also induce fever of this type.

Varieties of Inflammation.

Many different terms are used to indicate the manifestations of the inflammatory process in the body, and to some of these we must now direct attention.

A **Catarrhal** inflammation is one affecting mucous membranes which in the early stages become dry, vividly red, and the seat of a burning or scalding pain, whilst in the later stages there is free secretion of mucus, muco-pus, or pus. Pathologically, this process is accompanied, as are all active inflammatory changes, by hyperæmia and exudation. At first the mucigenous function of the membrane is abrogated, and any extravascular exudation passes into its substance, causing it to become swollen. Proliferation of the epithelium soon follows, resulting in an increased formation of mucus; as the membrane becomes more and more infiltrated with leucocytes, these are added to the discharge, which is thus trans-

The **Local Treatment** may be indicated under four headings.

1. *Remove the exciting cause*, if evident, and any contributory causes when feasible. This is not a difficult matter when the lesion is a gross one, and the exciting cause tangible—*e.g.*, a foreign body embedded in the conjunctiva or cornea, or a piece of dead bone lying at the bottom of a sinus. In a few cases, due to bacterial invasion, it may be practicable to totally excise a local focus—*e.g.*, a malignant pustule—whilst in others, such as a carbuncle, one can scrape away the sloughy and infiltrated tissue with a Volkmann's spoon and apply powerful antiseptics, such as liquefied carbolic acid or peroxide of hydrogen. In the majority of cases, however, all one can do is to relieve inflammatory tension, as by a free incision, thereby eliminating bacteria and toxins, and then build up the local and general resisting power of the tissues, so as to allow their natural reparative activities to assert themselves.

2. *Keep the inflamed part at rest.* Wherever inflammation exists, both physical and physiological rest should be obtained as far as possible. Thus, an inflamed joint is immobilized by a splint; an inflamed mamma needs both support and the fixation of the arm, whilst if in a condition of physiological activity this must be checked by suitable treatment; an inflamed cornea requires the application of a pad and bandage to prevent the friction of the eyelid; an inflamed retina must be given physiological rest by exclusion of the light.

3. *Reduce the local blood-pressure* and hyperæmia, and thus diminish both exudation and pain. It may be pointed out here that although both hyperæmia and exudation are beneficial, yet they are almost always present in excess, and it becomes needful to keep them under control. *Elevation* of an inflamed limb may secure this end, and is a most essential element in the treatment of all inflammatory conditions of the leg, for it is a well-known fact that emptying the veins by gravity in an elevated limb leads to reflex contraction of the arteries. *Local blood-letting* by leeches, punctures, scarification, and wet or dry cupping, is useful in suitable cases and sometimes gives immediate relief. It may be as well to mention that a leech can withdraw about 2 to 4 drachms of blood and that it should not be applied over a large subcutaneous vein, or to parts, like the scrotum or eyelids, where there is much subcutaneous tissue of a loose texture, in which extravasation readily occurs. The bleeding from a leech-bite usually ceases spontaneously but may require the application of slight pressure.

In diffuse inflammation of the cellulitic type *free incisions* are beneficial, partly on account of the relief of tension and pain which follows the escape of blood and retained discharges from the tissue but also because it determines a free flow of blood serum, and as this possesses antitoxic and germicidal properties, it assists in bringing the inflammatory process to an end.

Cold wisely utilized is of the greatest service in combating inflammation, causing contraction of the arterioles, and so reducing

stimulants, such as ether or carbonate of ammonia, whilst the recovery of patients lying in a typhoid state of exhaustion will absolutely depend on the administration at short intervals of nourishing fluids, combined with stimulants. In the sthenic type of inflammatory fever, 'antiphlogistic' means may be freely employed so as to reduce the general blood-pressure and remove irritating matters from the system, *e.g.*, a smart purge, followed by low diet and abstinence from alcohol for a few days; but in other instances where the blood-tension is high, as indicated by a large and full pulse, and the local signs (pain, etc.) are well marked, it may be also necessary to administer such drugs as antimony, aconite, full doses of acetate of ammonia, colchicum or ipecacuanha, in order to reduce the general blood-pressure, as also to obtain diaphoretic action. In a few cases, *e.g.*, acute meningitis, venesection may be needed, and it is possible that this is an agent too little employed in the present day. In some forms of inflammation due to the specific diatheses, suitable drugs must be employed to combat such tendencies—*e.g.*, salicylate of soda or salicin in acute rheumatism.

In inflammation of infective origin **serotherapy** may be found of use, but at present the only surgical affections in which this is generally applicable are erysipelas and a few other conditions due to streptococci, diphtheria, and tetanus.

Chronic Inflammation.

The phenomena of chronic inflammation are essentially the same as those of the acute process, though the manifestations are somewhat different. Hyperæmia and exudation occur, but the tissue reaction is much more prominent. The main differences between the two are as follows:

1. The hyperæmia is less in amount, but longer in duration, owing to the fact that the causative irritant is less intense in action, although often applied for a longer time. The local manifestations therefore are less obvious; pain is not so great and mainly of an aching character, whilst there is less heat, the redness is more dusky, and the tissues often become pigmented. Considerable loss of tone in the vessels, especially the veins, results from their prolonged distension, and thus there is greater difficulty in restoring them to a normal state.

2. The corpuscles do not adhere together or run into rouleaux to the same extent as in acute inflammation, and migration, though it exists, is on a limited scale. The exudation is more fluid in character, containing comparatively little albumen or fibrin; in fact, in some chronic inflammations of serous membranes the cavities are distended with fluid of a much lower specific gravity than that of blood serum.

3. The greatest difference between the acute and chronic processes lies in the reaction of the tissues. In acute inflammation, increased proliferation of the tissues is rarely a marked feature, since the toxin

dependent on the diathetic condition to which the local phenomena are due, or to septic changes developed secondarily.

The **Treatment** of chronic inflammation is usually more prolonged and difficult than that of acute cases, because of the constitutional dyscrasia which exists so frequently behind it.

1. The *cause must be removed* whenever possible. Dead or diseased bone must be removed, and tuberculous material got rid of by the knife or sharp spoon, whilst it is often desirable to supplement this by subsequently swabbing the parts over with liquefied carbolic acid. A chronic abscess increases the action of the original irritant hrough the tension engendered by its presence, and hence it should be dealt with as early as possible.

2. *Keep the part at rest.* This is just as much an essential as in the treatment of acute inflammation. Joints should be immobilized; the spine must have the weight taken from it by suitable appliances, or, better still, by maintaining the recumbent position; secretory glands are not actively exercised, and the organs of sense are protected from irritation.

3. *Counter-irritation* is one of the most useful forms of treatment for chronic inflammatory conditions. It is applied in many different ways, according to the character of the disease and the part involved. Thus, *friction* with the hand, or with stimulating embrocations, produces a hyperæmic condition of the skin, and promotes local activity in the superficial parts which may react beneficially on deeper structures. *Scott's dressing* may be similarly employed; it consists in wrapping up the part (*e.g.*, a joint) in strips of lint covered with ung. hydrarg. co. (containing over 10 per cent. of camphor), and then encircling it firmly with soap plaster, spread preferably on chamois leather. *Iodine paint* is another useful application, whilst *blisters* are most valuable in suitable cases. The *moxa*, a wound produced by burning a spirituous solution of saltpetre on the skin; the *issue*, the maintenance of a raw surface, however produced, by the constant presence of some irritant, such as the insertion of a bead, or the use of savin ointment as a dressing; and the *seton*, a double thread knotted at each end, passed for some distance under the skin, and drawn from end to end daily—all these are but little used now, although they might be occasionally employed with advantage. The *actual cautery* is the most severe form of counter-irritant, and is especially useful in some varieties of chronic inflammation of bones and joints.

4. *Pressure* is an important element in the treatment of chronic inflammatory disorders, and probably acts by artificially bracing up vessels which have become relaxed and atonic from the prolonged distension to which they have been subjected. It also favours the absorption of inflammatory exudations. Firm bandaging, and especially the use of an elastic support, are the usual methods of application.

5. A most valuable means of treating certain chronic inflammations, and indeed many other affections, consists in *Massage*. It is impossible

CHAPTER III.

EXAMINATION OF THE BLOOD IN HEALTH AND DISEASE.

ALTHOUGH an examination of the condition of the blood is frequently of great importance to the surgeon, a mere outline of the chief facts is all that can here be attempted.

The **red blood corpuscles** average about 5,000,000 to the cubic millimetre in men and about 4,500,000 in women, and are readily counted by means of the Thoma-Zeiss hæmocytometer or other similar instrument. The chief surgical value of such investigations arises in connection with hæmorrhage, for they enable us to determine the amount of blood lost at a surgical operation or as the result of a wound, and to trace the process of recovery. It is usually advisable to supplement the counting of the corpuscles by estimating the amount of hæmoglobin present by means of Haldane's or some other hæmoglobinometer, the result being expressed as a percentage of the normal amount. Thus, blood containing half the amount that should exist in a given bulk in a normal man is said to contain 50 per cent. of hæmoglobin. It is also convenient to calculate the 'corpuscular richness' or 'colour-index,' which is done by dividing the percentage of hæmoglobin by the number of corpuscles expressed as a percentage of the normal. For example, under normal conditions the hæmoglobin is 100 per cent., and there are 5,000,000 corpuscles per cubic millimetre, so that the colour-index is $\frac{100}{100} = 1$. If the corpuscles have fallen to 3,000,000 (60 per cent. of the normal), whilst the hæmoglobin has fallen to 30 per cent., the colour-index is $\frac{30}{60} = 0{\cdot}5$—that is to say, each red corpuscle contains only half as much hæmoglobin as it should do. In general a high colour-index is indicative of pernicious anæmia, and one which is greatly reduced of chlorosis, though in cases of severe secondary anæmia of long standing a similar reduction may be present.

If the blood is examined immediately *after* a patient has suffered from a severe *hæmorrhage*, it will naturally be found to be normal in composition; part has been lost, but the quality of the remainder has not altered. After a short time the volume of blood is restored to normal by means of fluid derived from the tissues. At this stage the blood is more diluted than normal, the red corpuscles and

bubo, as well as in hereditary syphilis; in the latter case it is often extremely well marked and of great value in diagnosis. It is sometimes present in anæmic patients who are not the subject of syphilis, and it is advisable not to place much reliance on a reaction obtained in a patient whose hæmoglobin to begin with is much below normal. It is useless in patients who are already under the influence of mercury.

The examination of the **leucocytes** is often of the greatest importance. It comprises an enumeration of the total number present per cubic millimetre, and a differential count of the relative number of the various kinds present. The former examination is carried out by a method similar to that used in counting the red corpuscles, and, as it takes but a few minutes and requires but little practice, should be learnt by all surgeons. The differential count is made on thin films of blood, which are dried and stained by a double or triple stain, Jenner's stain being the simplest and most useful.

Jenner's stain consists of a solution of eosinate of methylene blue in methyl alcohol. To use it the blood film is allowed to dry spontaneously and is then flooded with the stain, which is allowed to act for about two minutes. It is then poured off, and the film is rinsed in distilled water for a few seconds, drained, allowed to dry spontaneously, and mounted in Canada balsam. This is then examined under a $\frac{1}{6}$-in. lens, each leucocyte seen being noted down, until 400 or more have been counted. The results are reduced to percentages.

In health the blood contains from 4,000 to 10,000 leucocytes per cubic millimetre, five different forms of cell being present—the polynuclear leucocyte, the eosinophile leucocyte, the mast-cell, the lymphocyte, and the hyaline cell. Of these, the first three contain definite granules in their protoplasm, the others do not. In the following description we assume that the film has been stained by Jenner's method. If other staining processes are used, the colours of the various structures will naturally be somewhat different.

1. The *polynuclear* or *polymorphonuclear leucocyte* (Fig. 3, *c*) is rather larger than a red corpuscle. It is characterized by having a twisted or indented nucleus, which in badly-prepared specimens may appear to be multiple, although with proper preparation and the use of high powers of the microscope the connecting filaments between the various parts can always be made out. It contains in its protoplasm numerous very minute granules which have an affinity for acid stains, and hence are coloured pink by the eosin in Jenner's stain. In specimens which have not been well stained these granules may not be visible, but the cell can always be identified by its nucleus.

The polynuclear leucocytes are the chief phagocytic cells of the blood, being actively amœboid and endowed with the power of ingesting bacteria or other small objects. They are formed, mainly or entirely, in the bone marrow, and constitute in health from 65 to 75 per cent. of all the leucocytes.

2. The *eosinophile leucocytes* (Fig. 3, *d*) are about as large as the

origin and relation to the lymphocytes is not definitely known, but there is some reason for regarding them as endothelial cells which have been detached from the walls of the vessels.

An increase of the total leucocytes present in the blood is termed *leucocytosis*. Under most circumstances this increase is mainly due to an increase in the number of polynuclears present; special terms are used for an increase of other forms of leucocytes. An increase in the eosinophiles is called *eosinophilia*, and an increase in the lymphocytes is called *lymphocytosis*. A diminution of the leucocytes is termed *leucopenia*.

Leucocytosis occurs under *physiological* conditions during digestion, during pregnancy, and in the new-born infant. This has to be remembered in interpreting leucocyte counts in disease. The former factor is of especial importance, and if possible the blood should be collected whilst the patient is fasting.

Pathological leucocytosis occurs in many conditions, the most important being the infective diseases, and in these the highest counts are met with in pneumonia and in *suppuration*. The latter is of special importance to the surgeon, as the presence of a high leucocytosis may be regarded as the most definite single sign of the presence of pus. It is especially valuable in appendicitis, where the other evidences of suppuration are often equivocal. When no pus is present, the blood shows slight leucocytosis, the number not usually exceeding 15,000 per cubic millimetre. When pus is present the number is much greater, being usually not less than 18,000, and it may rise as high as 50,000, or even higher. For practical purposes a count of 20,000 leucocytes per cubic millimetre may be taken as an almost certain proof of suppuration, presuming, of course, that the other causes of leucocytosis can be excluded. Figures between 15,000 and 20,000 are not sufficiently definite to be of much value, and where they are obtained it is advisable to repeat the examination in twenty-four hours. If suppuration is taking place the count will almost certainly rise, whilst if it remains at the same level, or shows a decline, the presence of pus is unlikely. The height of the leucocytosis gives no indication of the size of the abscess or of the rapidity of its spread.

The opening of the abscess is usually followed by a fall in the number of leucocytes, and this is so rapid as to be quite definite in the course of twelve hours. When it does not take place, the probability is that a second abscess is present, which was overlooked at the time of the operation.

The absence of leucocytosis is presumptive evidence that suppuration has not occurred, but several facts have to be considered in applying this rule in actual practice.

1. The cause of the leucocytosis is the passage of the bacterial products from the inflammatory focus to the blood-stream, where they exert a positively chemotactic action, attracting the leucocytes from the bone-marrow, whilst at the same time they stimulate the latter to an increased production of leucocytes. As long as the

substance) in the protoplasm of the leucocytes in septic diseases. Dry blood-films are mounted in a solution of iodine 1, iodide of potassium 3, water 100, which has been saturated with powdered gum acacia. This stains the granules deep brown. This test is not as useful as the foregoing.

The relations of some of the other infective diseases to the leucocytes may be briefly epitomized. In pneumonia, erysipelas, diphtheria, scarlet fever, plague, and whooping-cough there is a high leucocytosis, the number rarely falling below 20,000. In rheumatic fever (uncomplicated), syphilis, and gonorrhœa there is usually a slight rise, and in tuberculosis, typhoid fever, influenza, measles, and malaria there is usually no excess, and often a diminution, in the number of leucocytes (leucopenia).

Pathological leucocytosis also occurs after severe hæmorrhage, and in all cachectic conditions, especially in that due to malignant disease. In these cases it is almost always due to a local inflammation excited by the new growth, and is rarely of diagnostic value In carcinoma of the stomach there is usually an absence of digestion leucocytosis, and this fact may assist in the diagnosis. The leucocytes are counted whilst the patient is fasting, and two or three times (at intervals of an hour) after a meal, which should include some meat. If the count does not rise considerably (2,000 per cubic millimetre or more), it affords strong presumptive evidence of the presence of malignant disease of the stomach, but, like all laboratory tests, must be considered in conjunction with the clinical phenomena

Lymphocytosis, or an increase of the lymphocytes, may be absolute or relative. A relative increase (*i.e.*, such that the percentage of these cells rises above 25, although the total number of leucocytes of all sorts does not exceed the normal) occurs in typhoid fever, tuberculosis, and malaria. A great excess of leucocytes (150,000 or more per cubic millimetre), the great majority being lymphocytes, occurs only in lymphatic leucocythæmia, and constitutes an important means of diagnosis between this condition and Hodgkin's disease, in which the leucocytes are normal or but slightly increased. Children's blood contains an excess of lymphocytes, reaching 60 per cent., and in inflammatory diseases of children the increase in the total leucocytes may be due partly to an excess of lymphocytes, and not only of the polynuclears, as in the adult. This is especially the case if the lymph-glands are involved in the inflammatory process.

Eosinophilia, *i.e.*, a relative increase of the eosinophiles, occurs several conditions: (1) In infection with animal parasites, especially in trichinosis, where the proportion may be 60 per cent. or more They are sometimes increased in hydatid disease; in doubtful cases this fact has some diagnostic value, but a count in which there is no increase is of little importance. (2) In skin diseases, especially when a large area of skin is involved. (3) In asthma. (4) In gonorrhœa, and a few other diseases.

fresh blood or blood-films, or by cultures; the method to be selected must depend upon the organism sought.

The diagnosis of *malaria* may be made by an examination of a wet film of fresh blood made by taking a small drop of the blood on a perfectly clean cover-glass and allowing it to fall on a perfectly clean slide; or films may be prepared in the ordinary way and stained by carbol-thionin, hæmatoxylin and eosin, Jenner's stain, or by other methods. For a description of the organisms and their life-history the reader is referred to special treatises.

Relapsing fever is due to a corkscrew-like organism (the *Spirillum Obermeyeri*), which is about two or three times as long as the diameter of a red corpuscle. They may be demonstrated by the method used for the malaria parasite, and in fresh specimens are as a rule actively motile.

The diagnosis of *filariasis* is best made by examining with a low-power lens thick layers of fresh blood taken at night, if *F. nocturna* is suspected; in the daytime, in the case of *F. diurna;* and at any time if *F. perstans* is sought.

Where bacteria are sought for in the blood, cultural methods are almost always necessary, for their numbers are usually so small that the chance of finding even a single specimen in a stained blood-film is remote. The blood must be drawn directly from a vein with a sterilized hypodermic needle and syringe (or better with a hypodermic needle mounted on a short length of glass tubing and the whole sterilized by heat), and full precautions must be taken in sterilizing the skin. At least 3 or 4 c.c. should be taken and inoculated directly into broth or melted agar, which is incubated and examined at the end of twenty-four and forty-eight hours. It is worse than useless to attempt to make a bacteriological examination of blood obtained from a skin puncture, however carefully the skin may have been sterilized.

In septicæmia, pyæmia, ulcerative endocarditis, and other diseases due to the pyogenic bacteria, the organisms may or may not be found in the blood. A positive result is most likely to be obtained in severe cases, especially when the blood is collected during a rigor; it is of evil omen, although such cases are by no means necessarily fatal. Cultures in which staphylococci are the only organisms to develop must be interpreted with caution, as being possibly due to accidental contamination. A negative result is usually of little value in diagnosis, as organisms may be absent from the blood for long periods in cases of septicæmia.

It is sometimes necessary to examine the blood for bacteria in the diagnosis of *typhoid fever*, especially when the infection is not due to the ordinary typhoid bacillus, but to one of its congeners (the paratyphoid bacillus, etc.). In general, the diagnosis is made by means of Widal's reaction.

however, the one may change into the other, and there is little doubt that the three really constitute one species.

Staphylococci are very widely distributed without the body, being common in air, dust, etc. They are frequently found in the human skin, though apparently not normal inhabitants of that region. Suppurative inflammations of the skin and subcutaneous tissue are due to staphylococci in the vast majority of cases; and when the inflammation is caused by other organisms in the first instance, a secondary infection with staphylococci almost always takes place later. Impetigo contagiosa, a disease due primarily to streptococci, may be taken as an example of this, and the vesicles of small-pox or vaccinia another, for in each case a secondary staphylococcic invasion takes place. The chief skin lesions due to staphylococci are abscesses, boils, carbuncles, pustular acne, etc. In some cases diffuse spreading cellulitis depends on the same cause, but this is unusual. Deep-

FIG. 4.—STAPHYLOCOCCI IN PUS. (FROM CROOKSHANK'S 'TEXTBOOK OF BACTERIOLOGY.')

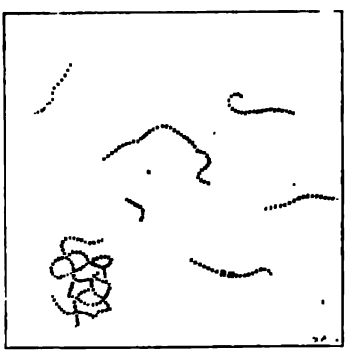


FIG. 5.—STREPTOCOCCI IN PUS. (REDUCED FROM CROOKSHANK'S 'TEXTBOOK OF BACTERIOLOGY.')

seated suppuration, such as osteomyelitis, peritonitis, empyema, etc., may also be due to staphylococci; in fact, they may cause suppuration in any part of the body. Lastly, staphylococcic septicæmia, pyæmia, or ulcerative endocarditis occurs, but is less common than the forms due to streptococci, and the prognosis appears to be slightly less grave.

Most cases of suppuration occurring after operations in which the antiseptic or aseptic precautions have been inadequate are due to staphylococci, either alone or in admixture with other organisms.

2. The *Streptococcus pyogenes* is an organism in which the individual cocci are arranged in longer or shorter chains (Fig. 5). It stains with Gram, and does not grow very easily on artificial culture media. A temperature approximating to that of the body is requisite, and hence it does not grow on gelatin. The colonies are small and translucent, and do not tend to spread or become confluent. I

the *B. coli* produces both acid and gas. These two bacteria are members of a large and important group of micro-organisms which have a close morphological resemblance to one another, but differ in their chemical activities. Of these, the most important are the bacillus of dysentery (of Shiga and others), the bacillus of Gaertner, a common cause of poisoning from stale meat, etc.

Under normal conditions the bacilli of this species, which occur in the intestinal contents, are not very virulent, but when any pathological condition arises in the gut their virulence appears to be increased, and an active invasion of the tissues may occur. Thus, the *B. coli* appears as a secondary infection of almost any inflammatory lesion of the abdomen. It is a very common cause of appendicitis, acute peritonitis, etc., and pus due to its action has usually a fæcal odour. It can also ascend the bile-ducts, and is the commonest cause of cholecystitis, cholangitis, etc. Lastly, the *B. coli* is one of the commonest causes of cystitis. It has, however, no power to render the urine alkaline; this is due to the presence of a micrococcus, formerly known as *M. ureæ*, but now believed to be identical with *M. epidermidis albus*, an organism of constant occurrence in the skin.

5. The *typhoid bacillus* sometimes causes abscesses, especially in connection with the bones, after an attack of typhoid fever. In some cases the organism may lie latent for years before suppuration occurs.

6. The *B. pyocyaneus* is a comparatively rare cause of suppuration. The pus which it causes turns bluish-green when exposed to the atmosphere. It sometimes gives rise to a general infection.

7. The *Gonococcus* (see p. 129).

8. The *M. tetragenus*, an organism in which the individual cocci occur in tetrads, is rarely met with.

Many cases of suppuration are due to a *mixed infection* with two or more of the species of bacteria enumerated above. In other cases an abscess may be formed by the action of one of the pyogenic bacteria, and be subsequently inoculated with other species, which may be simple saprophytes that have the power to grow in the dead pus, but cannot invade the living tissues. This accident is very likely to occur in a large abscess when the drainage is insufficient and the dressings are not performed with sufficient care; it should be carefully avoided, for, as a general rule, lesions due to a mixed infection heal with difficulty; it would seem as though the tissues can more easily acquire immunity to a single organism than to two or more at the same time. The fact that a wound is already septic is not, as it is too frequently considered to be, any reason for neglecting to treat it with the fullest antiseptic or aseptic precautions.

abscesses which sometimes develop months or years after an attack of typhoid fever, and which are due to the typhoid bacillus, though in this case we cannot exclude the possibility of a subsequent infection with the same certainty as in the case of leprosy. In what state the bacteria lie latent in the tissues and the nature of the conditions which excite them into activity are unsolved problems; we should expect the latter phenomenon to be due to general ill-health or to local injury, but cases occur in which no such factors can be traced. It is probable that they would regain their activity if an operation took place in a region in which they were deposited. If this were the case the wound would suppurate, although the antiseptic precautions were perfect in every detail. A group of cases of very different nature occurs when pyogenic bacteria are carried from a suppurative lesion in one part of the body to another region, where they induce a *secondary embolic abscess;* this occurs in pyæmia, gonorrhœa, etc.

(*c*) *Sterilized foreign bodies* (*e.g.*, silver wire or glass splinters) *do not produce suppuration*, except in the rarest of cases, by auto-infection. Thus, a ragged splinter of glass, 1¼ inches long and 1½ inches wide, the result of the bursting of a soda-water bottle, was cut out of the neck of a hotel porter ten months after it had entered; it had caused no suppuration. This fact is constantly made use of at the present day in surgical practice; deep layers of the tissues are brought together by carefully sterilized buried sutures, and divided structures such as bones, ligaments, etc., are approximated and held in position by wire, screws, pegs, and various forms of buried appliances, which would cause endless trouble but for their complete sterilisation.

In conclusion, therefore, although we have to admit that suppuration may be experimentally induced in animals in the absence of micro-organisms, *in man for all ordinary conditions suppuration does not occur apart from the presence and vital activity of specific bacteria.*

The **causes** of an acute abscess may for practical purposes be grouped under the three following headings: (1) The individual affected is possibly in a depressed and unhealthy state, and the germicidal properties of his tissues may be defective. (2) A local nidus must exist, which is in a condition of lowered vitality, from injury, cold, or otherwise; and (3) this spot must become infected with pyogenic organisms brought to it either from within or without the body.

Formation and Structure of an Acute Abscess.—The bacteria which have gained access to the tissues grow and produce their toxins, and these diffuse into the surrounding structures, giving rise to acute inflammation; the vessels dilate, acceleration of the blood-stream occurs and is replaced by retardation and thrombosis, and the leucocytes emigrate. The toxins then act still more powerfully on the injured tissues and destroy their vitality, usually by a process of coagulation-necrosis. A section through the lesion at this stage will show two well-differentiated zones (Fig. 6): a central area in which the tissues are dead, have lost their staining properties, and contain the pyogenic

The fate of the small slough varies according to circumstances. It may occasionally be recognised when a small abscess is opened —*e.g.*, the core of a boil—but in most cases it is absorbed by the leucocytes or digested by the peptonizing enzyme which many pyogenic bacteria form, and no trace remains. It may even happen that no definite slough is ever formed, the earliest effect of the bacteria being to attract the leucocytes in vast numbers into inflamed but still living tissues, which are then killed and digested cell by cell.

This collection of leucocytes suspended in plasma and surrounded by a zone of inflamed tissue constitutes an *abscess*. The leucocytes and fluid are collectively termed *pus*, and it is important to recognise that the characteristic cells of the pus from an acute abscess are the polynuclear leucocytes. These, however, differ somewhat from those seen in blood-films. Many of them are killed by the toxin (as can be seen from their loss of motion when the fresh pus is examined on a warm stage), and undergo various degenerative changes. Many of them contain bacteria.

At first the abscess often extends rapidly, but after a day or two (in most cases) a certain amount of local immunity is produced, and the abscess spreads more slowly. This is an indication of the fact that the tissues, which were at first overwhelmed by the action of the bacteria and their toxins, are now carrying on the contest on more even terms. At this period the cavity becomes lined by *granulation tissue*, which forms a thick, soft layer of velvety appearance and bright-pink colour. It is composed of large numbers of loops of newly-formed bloodvessels, which are distended with blood and embedded in a mass of leucocytes and tissue-cells in a state of active proliferation. These vascular loops (clothed with a layer of leucocytes, etc) project on the surface, giving rise to the small granulations from which the tissue derives its name. Granulation tissue differs from the inflamed tissues which form the wall of an abscess which is rapidly extending, in that in the former case some attempt at repair has taken place. Its appearance does not necessarily indicate that the abscess has entirely ceased to spread, for the toxins may still be powerful enough to kill the delicate newly-formed tissue cell by cell; but in most cases it is the first indication of the ultimate victory of the tissues. Leucocytes continue to pass from the thin-walled vessels of new formation into the abscess cavity, being attracted chemotactically by the substances present in the pus; hence the layer of granulation tissue appears to secrete pus, and was formerly called a pyogenic membrane. Its appearance was anxiously looked for by surgeons in the days when suppuration was considered essential for the healing of wounds, and for a very good reason. It opposes a strong barrier to the bacteria and their toxins, and in large measure prevents their entering the blood-stream. Thus the formation of thick, creamy pus of a yellowish colour, such as is produced by such a pyogenic membrane, was looked upon as a sign that the patient was practically out of danger of septic absorption. Such pus was termed 'laudable.'

throbbing in character. Naturally, the amount of this pain depends entirely upon the density of the tissue affected and the supply of sensory nerves to the part, suppuration beneath a resisting membrane, such as the palmar fascia, being always intensely painful. If left to itself, an abscess sooner or later points and bursts. As it increases in size, it exerts pressure in all directions, and naturally seeks to find an exit in the line of least resistance, and so may either find its way to the surface, or may burrow along muscular and fascial planes, or into adjacent cavities. This is not merely a mechanical, but also a vital process, as already described. The actual bursting of an abscess is often due to some injury—it may be a slight one—but is usually preceded by ulceration of the integument, or perhaps, if the abscess is a large one, by necrosis.

2. *Pressure effects* are mainly due to the mechanical influence of the swelling upon surrounding structures. The most evident are those due to the irritation of nerves, as a result of which neuralgic pain may be present, or the patient may refer the pain to some distant unaffected region. In some cases, where bloodvessels are involved, the tissue around them disappears, and they are left in the abscess cavity as bands, surrounded by granulation tissue. Thrombosis and the subsequent obliteration of the vessel may result, or occasionally ulceration and hæmorrhage (ulcerative periarteritis), preceded perhaps by an aneurismal dilatation of the vessel, owing to its loss of external support. Such effects are more common in chronic than in acute abscesses.

3. The *general effects* of the formation of an acute abscess are those of increased fever, sometimes amounting to a rigor, and leucocytosis. A *rigor* consists of a definite series of phenomena, the result of some stimulating influence reaching the thermogenic centres of the medulla, and determining a sudden increase of activity. It is very similar in nature to an attack of ague, being ushered in by a feeling of intense cold and discomfort; the features are pinched, and the teeth chatter. The skin, however, feels dry and hot, and the temperature of the body rapidly rises. The sensation of cold is partly due to the contact of air at a maintained normal temperature with the hot, dry, unperspiring skin, and also possibly to the condition of superficial anæmia which is present. After this stage has lasted a variable period, the patient gradually begins to feel warmer, the face becoming flushed, the thermometer ceasing to rise, and the skin commencing to act. Finally there is a rapid fall of temperature accompanied by profuse perspiration, which leaves the patient more or less exhausted.

For *leucocytosis* and its value in the diagnosis of suppuration, see p. 48.

Pus and its Constituents.—Normal, or as it was formerly called, healthy or laudable pus, is a thick, creamy fluid, having a specific gravity of about 1030, an alkaline reaction, no smell (unless putrefying or under special circumstances), and containing 85 to 90 per cent. of water. If allowed to settle, it separates into two layers, an

however, by palpating along the course of its fibres. In cases of doubt a blood count should be made, and the demonstrated presence of leucocytosis would be an important diagnostic feature (p. 48).

Treatment of Acute Abscess.—When an inflamed area is threatening to suppurate, the formation of pus can be but rarely *prevented*. In the early stages, elevation and rest of the part, together with the application of evaporating lotions and the administration of quinine with iron, may sometimes succeed in accomplishing this. The hypodermic injection of powerful antiseptics—*e.g.*, pure carbolic acid—has also been employed to destroy the pyogenic organisms *in situ*, whilst in some cases (*e.g.*, in acute periostitis) a free incision through the inflamed tissues is permissible.

In a few regions of the body, pus may be *absorbed* after its formation, but only when situated in a cavity of highly-absorbing powers, such as the anterior chamber of the eye (hypopyon), or perhaps some of the serous cavities, *e.g.*, the peritoneal. In the former the process of absorption may certainly be observed under the influence of local and general treatment.

As a rule, however, one encourages suppuration by applying fomentations or poultices to the part, and then as soon as pus is evident, an incision is made to *evacuate* the abscess cavity. The opening must be large enough to prevent re-accumulation; it should be placed at a spot suitable for drainage, but as far as possible from sources of septic contamination, and in such a direction that movements of the part do not close it. In dealing with deep abscesses in dangerous regions, *Hilton's method* may be advantageously employed. It consists in merely dividing the skin and superficial structures, and then thrusting a director into the abscess cavity; a pair of sinus or dressing forceps is now passed along the groove, and on forcibly separating the blades a sufficient opening is made to insert the finger and subsequently a drainage tube. Rigid antiseptic precautions must be taken in opening abscesses, for although bacteria are present, it is most essential that no fresh germs be admitted, thereby giving rise to a mixed infection the presence of which is most unfavourable to rapid repair.

Methods of Opening Various Abscesses.—*Axillary Abscess.*—Cut in the median line of the axilla towards the chest from above downwards, and use Hilton's method, thus escaping the three main sources of danger, viz., the axillary vessels above, the long thoracic in front, and the subscapular vessels behind.

Inguinal Bubo.—Make a vertical incision from below upwards, the patient standing erect against a wall or lying down. When he sits the incision gapes and so accumulation is prevented.

Intramammary Abscess.—Cut in a direction radiating from the nipple to prevent injury to the galactophorous ducts, and pass a finger in so as to open up all the dilated lobules.

Submammary Abscess. Open along the lower margin of the breast, and, if possible, towards the outer side, carefully avoiding the glandular tissue.

Retropharyngeal Abscess.– Incise along the posterior border of the sterno-mastoid for about an inch; draw that muscle and the carotid sheath forwards; open by Hilton's method, pushing a director inwards to the middle line immediately in front of the transverse processes, guiding it by means of the left index-finger placed on the swelling in the mouth.

culous nature, unless otherwise stated. The clinical phenomena are alike in the two types, and will be dealt with later (p. 167), but there is one important distinction between them, in that the lining membrane of the pyogenic variety is merely granulation tissue more or less active, whilst in the tuberculous form it contains active tuberculous material. Hence, whilst a simple incision under aseptic precautions is all that is required in the former, the latter also needs removal of the tuberculous tissue by scraping or some such agency.

Sinus and Fistula.

When an abscess has been opened, and does not completely heal, a communication often persists between the original seat of the disease and the exterior, which is known as a sinus or fistula. A **Sinus** is a narrow track lined with granulations, penetrating into the tissues, open at one end and closed at the other; the discharge is purulent or merely serous according to whether or not sepsis is present. A **Fistula** is an abnormal communication, congenital or acquired, between two cavities, or between a cavity and the external surface. When such conditions result from the non-closure of an acute or chronic abscess of pyogenic origin, the walls consist of an external fibro-cicatricial vascular layer, merging on the outside into healthy tissues, and an internal lining of more or less healthy granulation tissue. Should the abscess have been of tuberculous origin, the lining membrane will also contain tubercles. If the fistulous track is short, there is a tendency for the granulating wall to become covered with epithelium, and under such circumstances it cannot be expected to close until the epithelium has been removed, and a raw surface again exposed.

It is often a matter of difficulty to secure the healing of a sinus or fistula, and the following are the main *causes of their non-closure:* (1) The presence of some chronic irritant in the depths of the wound, such as a piece of the clothing, a catgut ligature, a piece of silk or silver-wire used in an operation, or of some diseased tissue, such as a fragment of dead or carious bone; (2) the irritation of discharges finding an exit through the abnormal opening, such as urine, fæces, or fœtid pus; (3) insufficient drainage of a deep cavity, so that there is always a certain amount of tension in the wound; (4) want of rest to the part, due either to voluntary movements, as in the limbs, or to involuntary muscular action in the immediate neighbourhood, as in fistula-in-ano; (5) tuberculous infection of the wall, or a tuberculous deposit at the bottom of the sinus; (6) the growth of epithelium down the sinus or round the margin of the fistula; or (7) constitutional debility.

The orifice of a sinus often looks depressed from the amount of infiltration around, but when the surrounding tissues are healthy puckering in of the orifice is a good sign; in cases where foreign bodies are lodged within, or where diseased bone exists, it is usually surrounded by prominent fungating granulations.

perspiration breaks out which soaks the patient's clothes, and leaves him in a much-exhausted condition. Day by day this continues, the fever and sweating together causing a marked diminution in the patient's strength.

Amyloid, Albumenoid, or Lardaceous Disease of various organs is also present in cases of long-standing suppuration. As to the cause of this curious condition but little is known; either from the deleterious effects of toxic compounds circulating in the blood, or from the loss of some special substance in the discharge, *e.g.*, alkaline phosphates, the walls of the smaller arteries and the protoplasm of

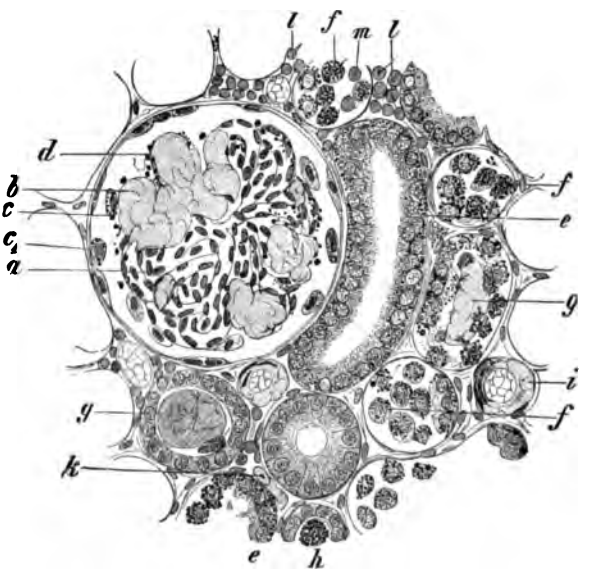


FIG. 9.—AMYLOID KIDNEY IN EARLY STAGE. (ZIEGLER.)

(Treated with Müller's fluid and perosmic acid. × 300.) *a*, Normal capillary loop; *b*, amyloid capillary loop; *c*, fatty epithelium of glomerulus; c_1, fatty epithelium of capsule; *d*, oil drops on the capillary wall; *e*, fatty epithelial cells *in situ*; *f*, loosened fatty epithelial cells; *g*, hyaline coagula (forming 'casts'); *h*, fatty cast in section; *i*, amyloid artery; *k*, amyloid capillary *l*, infiltration of connective tissue with leucocytes; *m*, round cells (leucocytes) within a uriniferous tubule.

certain of the viscera are converted into or infiltrated with a waxy substance, from which lardacein, an extremely insoluble proteid body, may be obtained. The name 'amyloid' is an entire misnomer as this material is in no way akin to starch. It occurs as a waxy homogeneous material, becoming a dirty brown on the application of tincture of iodine, and an inky blue when sulphuric acid is subsequently added. With methyl-violet the amyloid substance is coloured ruby-red, whilst normal tissues are stained blue or indigo

which are not properly drained are amongst the most favourable for the development of this condition, especially if the general health of the individual is bad, if he is suffering from albuminuria or diabetes, or if his surroundings are of an insanitary nature. Wherever much loose cellular tissue is present, inflammatory phenomena readily supervene, owing to the absorption of septic material from neighbouring contaminated structures, *e.g.*, pelvic cellulitis arising from a septic uterus.

Bacteriology.—The *Streptococcus pyogenes* is the organism most frequently found in cases of cellulitis, particularly when there is much tendency to spread. In some of the more localized forms the *Staphylococcus pyogenes* is present, whilst in the gravest and most acute manifestation the *B. œdematis maligni* is responsible for the trouble (p. 108), and the disease is then identical with what is usually known as acute emphysematous or infective gangrene.

Clinical History.—The symptoms necessarily differ somewhat according to the site of inoculation and the virulence of the causative microbes, and hence anything from a localized suppuration to the acutest form of spreading gangrene may result. In a case of moderate severity, due to a prick or abrasion which has become infected, there is often a period of quiescence for a day or two, during which the virus is incubating, and the site of inoculation shows but slight signs of inflammation, beyond being a little tender. The patient, though feeling somewhat seedy, is able to continue his work, but is finally obliged to give up, owing partly to the increased pain, partly to his general condition. Fever will almost always be present to a greater or less degree, and in the more severe types one or more rigors occur, or the temperature may be subnormal, owing to the intensity of the toxæmia. The affected part is found to be hot, tender, and infiltrated; if superficial, it looks red and angry, and feels brawny. The course of the case depends to a very large extent upon the treatment adopted; if freely incised, the process becomes limited, and although suppuration may occur, there is but little sloughing, and hence repair is readily effected; if, however, it is left or is merely poulticed, the process rapidly spreads, and extensive destruction of tissue may follow. Intense pain and sleeplessness, accompanied perhaps with delirium, form the most prominent symptoms, and these, together with the toxic fever, rapidly exhaust the patient's strength. Suppuration at length occurs, but it is often of slow development, and the swelling may remain hard and brawny for some time in such a region as the neck with no evidence of softening; it is, therefore, sometimes very difficult to determine whether pus is present or not. The infiltrated cellular tissues are likely to slough, and in a limb extensive subcutaneous necrosis may occur, although the skin only gives way in places. Hence it is often possible to pass a probe between the skin and the deep fascia over a considerable area. Sometimes the inflammation skips a part of the limb, the chief focus of mischief being found at a distance from the original site of inoculation, whilst the intervening portion

The results have been very variable; sometimes it is most effective, but not unfrequently the results have been most disappointing. This is probably due to the extraordinary differences in virulence between different strains of streptococci.

Special Varieties of Cellulitis.

Cellulitis of the Axilla not unfrequently follows an infected wound of the hand, such as occurs in the post-mortem room, and hence is not uncommon in medical practitioners, students or nurses. It may also be caused by extension from a primary axillary lymphadenitis. The tissues of the armpit become hard and brawny, the pain is severe, and the disease is liable to spread towards the chest walls under or between the pectoral muscles; it may also travel upwards, and lay open the shoulder joint from sloughing of the capsule, and so give rise to an acute arthritis. Extensive incisions are required in order to prevent such complications, but respect must be paid to the important vessels and nerves contained in the cavity.

Submammary Cellulitis is usually due to an extension of inflammation from the deeper parts of the breast, or perhaps from the cartilages or bones of the chest wall. The areolar tissue beneath the breast becomes infiltrated and brawny, and the gland itself is lifted up, and somewhat swollen and tender. (See Submammary Abscess.) Free incisions must be made into the infected area along the lower portion of the circumference of the organ.

Cellulitis of the Scalp results from a septic wound which has traversed the occipito-frontalis aponeurosis, and opened up the subjacent layer of loose areolar tissue. Suppuration extends to the limits of attachment of this structure, and hence abscesses are likely to point in the forehead just above the eyebrows over the zygoma, or along the superior curved line of the occipital bone; in addition to the severe general disturbance, the patient runs a risk of necrosis of the skull and of various intracranial complications.

Cellulitis of the Orbit is not an uncommon sequela of penetrating wounds in this region, owing to the difficulty of rendering them aseptic and of draining them. The whole of the orbital tissues become infiltrated and swollen, the lids are œdematous, and the eyeball is thrust forwards. There is a considerable likelihood of the inflammation spreading to the meninges, owing to the dura mater being continuous with the orbital periosteum through the foramina by which the nerves and vessels enter. Necrosis of the orbital walls may also occur whilst the eye itself may suffer either from an infective panophthalmitis due to lymphatic infection, or from optic neuritis secondary to retro-ocular inflammation and pressure, or at a later date from optic nerve atrophy secondary to cicatricial contraction around the nerve. If the cellular tissue of the orbit sloughs, the subsequent movements of the globe may be much hampered, or indeed lost, whilst the lids may be drawn back to such an extent as to prevent their complete closure. *Treatment.*—No penetrating wound of the orbit ought to be closed if there is any question of its infection; indeed, it is often wise to slightly increase its size, so as to enable the deeper parts to be cleansed. Drainage must always be provided for, and in many cases this is best accomplished by stuffing it lightly with gauze. If cellulitis follows, the original wound must be opened up, and possibly fresh incisions made either through the lids or through the fornix conjunctivæ. Antiseptic fomentations or poultices are then applied. If panophthalmitis supervenes, the eyeball must be incised crucially; this is a safer proceeding than enucleation, which is more liable to be followed by meningitis.

Cellulitis of the Neck is a painful and serious affection which is usually secondary to a septic throat, and may therefore be associated with follicular tonsillitis, diphtheria or scarlatina. In it the tissues beneath the deep cervical fascia become infected, usually with streptococci, and sooner or later suppuration occurs. The affected side of the neck becomes swollen, red and brawny; severe pain of a deep tensive character is experienced, and this is increased by move

III. Sepsis and Sapræmia.

Sepsis is a term somewhat loosely applied to indicate that a wound or sore has become infected with micro-organisms in such a way as to interfere with healthy reparative action. It is seen in connection with casualty wounds, and less frequently in operation cases; it occurs in abscess cavities, and in connection with other unprotected sores and abrasions, and the offensive odour which so often accompanies neglected syphilitic or cancerous lesions is simply due to this, and is no essential part of the causative affection.

The organisms present are usually of the ordinary pyogenic type, especially the staphylococci and streptococci, but other saprophytic germs may sometimes be found, constituting a mixed infection.

When it arises in connection with a casualty or operation wound, it is usually due to contamination from a dirty state of the skin, impure instruments, ligatures or sutures, unsterilized hands of the surgeon or assistants, or some other fault connected with the operative technique; very rarely it is due to auto-infection or to the fact that pyogenic germs are lying latent in the part as the result of some former infective trouble in the neighbourhood. The *local* trouble is acute or subacute, according to the virulence of the organisms and the resisting powers of the patient; it may manifest itself merely as a suppurative process within the wound, or as an active cellulitis spreading into the adjacent tissues. It may commence deeply around a buried stitch or superficially. In the latter case the lips of the wound look red and puffy, the tissues often swell up between the stitches, which look as if they were too tight; the patient complains of pain, usually of a throbbing nature, and there is some rise of temperature, and in bad cases even a rigor. In the milder forms, the trouble is limited to the immediate neighbourhood of the wound; but if neglected, or in an unhealthy subject, or if due to virulent germs, the phenomena of an acute cellulitis may supervene, whilst the general condition may constitute an attack of septic traumatic fever, or may even run over into a true septicæmia.

When the process starts quietly in the deeper parts of the wound, nothing may be obvious on the surface for a few days, except perhaps some fulness and tenderness on pressure. It will usually be found, however, that the temperature is slightly raised, and that some tensive pain is present. Sooner or later an abscess develops and comes to the surface.

The **local treatment** of a septic wound consists essentially in the relief of all tension, the removal, as far as possible, of all putrescible material, and the application of warmth and moisture to the part, if superficial, to encourage the local reparative activity of the tissues. Stitches must be immediately removed, and the wound widely opened up, care being taken to ascertain whether or not the pus has burrowed, as if so it must be followed up; sloughs may be cut or scraped away under an anæsthetic, or left to separate by natural processes. The parts are then thoroughly washed out with warm

cause has come into operation, with a severe rigor, followed by a maintained high temperature, although sometimes it is subnormal in the more serious cases. This is associated with loss of appetite, a dry tongue, a quick pulse, rapidly becoming weak, severe headache, and nocturnal delirium of some intensity. The patient is at first constipated, but vomiting and diarrhœa may ensue from gastro-intestinal irritation, followed by fatal exhaustion and collapse, or he may become comatose and unconscious for some time before death, according to whether the toxins act chiefly upon the alimentary system or upon the cerebral centres. Dyspnœa, from pulmonary congestion, and albuminuria also occur. Should, however, the putrefying mass be removed in time, the fever will cease as by magic, the tongue cleans, the appetite returns, the headache vanishes, and in twenty-four hours the patient feels a different individual.

Post-mortem Appearances.—Decomposition is early, rigor mortis feeble, and cadaveric lividity well marked, especially along the lines of the superficial veins and posteriorly. The blood coagulates imperfectly, and is dark and tarry in colour; if allowed to stand, the serum which separates from the corpuscles is much stained from the breaking up of the red-blood cells which occurs in all septic and infective cases. This condition explains the amount of cadaveric lividity, and also the post-mortem staining of the endocardium and tunica intima of the larger vessels, which is such a marked feature in these cases, and which was formerly supposed to result from a diffuse arteritis. Most of the serous cavities contain a certain amount of blood-stained fluid, and under almost all the serous membranes are well-marked petechiæ, especially under the pericardium and pleura. The lungs are deeply congested, particularly at the back, and very œdematous; the liver, spleen, and kidneys are enlarged, pulpy, soft, and congested, notably the spleen. The epithelium of most of the secreting glands, if examined microscopically, gives evidence of cloudy swelling.

The **Treatment** of acute sapræmia must be chiefly directed to the local cause, which is dealt with by suitable surgical means. General treatment is merely symptomatic. Possibly a good purge may be advisable in the early stages, but in the later a supporting and stimulating plan of treatment must be adopted. Recently it has been proposed to deal with the acute toxæmia of peritonitis and similar conditions by the repeated injection into the veins of large quantities of saline solution (℥i. ad Oi.), and excellent results have been obtained by this means, the injections being followed by diuresis and diarrhœa, which presumably assist in the elimination of the poison.

IV. Septicæmia.

Septicæmia is an acute general infective disorder, arising from the development of some variety of pyogenic organism in the blood. It differs from pyæmia in the absence of secondary abscesses (although, as explained later, it may be associated with it), and from sapræmia

delirium, becomes comatose, and dies. Dyspnœa sometimes precedes the fatal issue, whilst the temperature may be exceedingly high, or occasionally subnormal; the association of a low temperature with a very rapid pulse is always of grave import.

Illustrative Cases.—A servant-girl, aged about twenty-two, complained one hot summer's day that she had been stung near the inner canthus by a fly; possibly the insect had come from some infected material, and thus poisoned the wound. In twenty-four hours she was feeling ill and feverish, and had some chills and flushes; a painful swelling developed at the inner canthus, which rapidly increased in size and spread downwards. At the end of four days, when we saw her, the eye was protruding and much congested, and a definite band of inflammatory thickening could be felt reaching from the roof of the nose across the face to the neck and jugular region, probably the thrombosed facial vein, the clot doubtless extending to the cavernous sinus. The temperature was high, and the girl was delirious. An incision was made into the orbit with the view of relieving tension and giving exit to any pus that might be present, but with no result. She rapidly became unconscious, and died within a week.

An elderly man, addicted to drink, fell in the street, and grazed the inner side of his hand. Within twenty-four hours the whole arm was puffy and swollen, and in two days gangrene had manifested itself, the infiltration reaching beyond the shoulder. The patient was dead from acute septicæmia in five days.

The **Post-mortem Signs** are those found in all cases of acute septic poisoning, described above (p. 78), with the addition that on microscopical examination bacteria can be demonstrated in the blood and internal organs.

The **Diagnosis** has to be made from the more virulent forms of the *acute exanthemata*, in which the patient is destroyed before the characteristic appearances are manifested; in such cases a definite opinion as to the nature of the affection is often impossible, if there is no clue as to the origin of the infection. *Sapræmia* is always associated with some very obvious focus of putrefaction, whilst septicæmia *may* occur with but slight local manifestations. *Septic traumatic fever*, due to wound infection, may be so severe as to cause grave anxiety for a time as to whether or not septicæmia is present; but if the wound is freely opened up and drained, the rapid disappearance of the fever proves that the mischief was merely a local, and not the more serious general, affection. In both these conditions a blood examination *may* assist in clearing up the diagnosis. From *pyæmia* it is known by the absence of repeated rigors and secondary abscesses.

The **Prognosis** of septicæmia is always very grave, but it is to be hoped that the modern plans of treatment mentioned below, especially serotherapy, may prove beneficial in diminishing the mortality.

The **Treatment** consists in dealing actively with any local focus of inflammation, either by amputation, or by free incisions, purification, and drainage; but unfortunately this is seldom likely to be successful, as blood infection has probably already occurred. In addition to such means, tonics and stimulants, with plenty of suitable nourishment, must be administered.

It is possible that even this grave disease may become amenable to some of the therapeutic measures which have been suggested of recent years. Thus, the antistreptococcic serum (p. 73) may be

occasionally met with in casualty work, where efficient asepsis is difficult. Acute infective inflammation of the cancellous tissue of bones is very commonly associated with pyæmia, owing to the veins being abundant and thin-walled, and considerable tension present from the unyielding condition of the surrounding bony structures. Inflammation of the cranial bones coming on in the course of middle-ear mischief, and causing thrombosis of the lateral sinus, also leads to its development. The presence of large open-mouthed veins in the puerperal uterus favours the onset of the disease after parturition if septic material is present in their vicinity.

When an infective embolus lodges in any region of the body, a thrombus forms upon it, and in this the micro-organisms rapidly develop, and thence pass through the vessel wall into the surrounding tissues, causing inflammation, which is at first of a plastic type, but later on is likely to suppurate. In the lung many such foci may occur, distributed mainly along the posterior border and near the surface; each is sharply limited to a wedge-shaped area of tissue, with the base directed towards the periphery. It is at first reddish in colour from effusion of blood (a *hæmorrhagic infarct*), but soon becomes grayish-yellow from the formation of pus. These abscesses are small, and rarely give rise to any physical signs. Similar collections of pus, preceded or not by an infarct, may be found in any organ of the body. The lungs, acting as a filter to emboli derived from the systemic veins, are naturally the first organs to be affected, and from the abscesses formed therein infection of the arterial system may take place, resulting in fresh suppurative foci in the liver, spleen, kidneys, brain, and in or around joints, etc. If, however, the causative phlebitis is situated in the portal area, the emboli are lodged primarily in the liver, giving rise to what is known as *pylephlebitis*. When the emboli are many in number, the symptoms are severe, constituting **acute pyæmia**; this is sometimes associated with a development of micro-organisms in the blood, producing *pyosepticæmia*, the patient perhaps dying before the secondary abscesses have fully developed. In other cases the general symptoms are due rather to the absorption of toxins from the local foci than to the development of organisms in the blood. If the emboli are few in number, and there is little or no development of microbes in the blood, the disease is termed **chronic pyæmia**.

Clinical History.—The most marked symptom indicating the onset of a case of **Acute Pyæmia** is the occurrence during a period of febrile disturbance of a severe rigor, which is repeated with a sort of irregular periodicity, most frequently at intervals of about twenty-four to forty-eight hours, somewhat simulating an attack of ague. The rigors do not differ from those occurring in other diseases, but they are very severe, and usually followed by profuse sweating. Between the rigors the temperature may fall to the normal, but more commonly remains above it. The skin is hot and soon develops an earthy or dull yellow tint, together with erythematous or petechial patches. A sweet, mawkish, hay-like smell of the breath is very characteristic.

body, most frequently in the lungs, and their different stages can be clearly demonstrated from the embolic colonies of micrococci, through the stage of hæmorrhagic infarction to the complete abscess. The contained pus may be of the normal type, or thin and oily; it is always, however, swarming with cocci. 4. The general signs common to all cases of septic poisoning (p. 78) will also be manifest.

The **Diagnosis** of pyæmia should not be difficult in the majority of cases; but when it originates without any obvious external wound from a deep-seated focus, or if the importance of some local lesion has not been appreciated, the initial symptoms may be mistaken for those of acute rheumatism or ague.

The **Prognosis** depends upon the inherent vitality of the patient and the virulence of the disease. In acute cases it is extremely grave, whilst in the chronic type recovery is not only possible, but probable, if the local abscesses are favourably situated.

In the **Treatment** of acute pyæmia the surgeon is acting at a considerable disadvantage, in that the disease is only recognisable when it has obtained some hold upon the patient, since the recurrent rigors, by which it is known, are usually the evidence of a grave general infection of the blood.

Local treatment is most important, and since the disease is in the majority of cases due to the detachment of infected emboli from a vein, the ideal surgical practice consists in preventing, if possible, the further contamination of the general blood-stream. This can sometimes be accomplished, in the case of a limb, by amputation well above the local lesion; or if the medullary cavity of a bone is the source of trouble, it may be possible to scrape out the gangrenous and offensive medullary tissue, and disinfect the cavity with pure carbolic acid; or if it is due to a wound in the soft parts, it may be feasible to dissect out the implicated vein and surrounding tissues, or at any rate to remove the disintegrating clot after placing a ligature upon the vessel between the thrombus and the heart. A typical illustration of such treatment is that adopted for septic thrombosis of the lateral sinus complicating disease of the middle ear, where, after tying the internal jugular in the neck, the sinus is exposed by the trephine or gouge, opened, and all the septic clot removed, partly from above, partly from below. Admirable results have been thereby obtained. The *abscesses* must be dealt with, where practicable, by opening them early and washing them out; such wounds often heal well, and joints which have been distended with pus may recover with free mobility. Occasionally, however, although rigid asepsis has been maintained, the suppuration continues, and even sloughing of the abscess wall may follow. If the general condition can be improved, a barrier of granulation tissue will form in time, and repair be established.

Constitutional treatment consists in supporting the patient's strength by nourishing diet and stimulants, and in taking precautions to avoid bedsores or any local injury. Salicylate of quinine may be administered, though its value is doubtful. The antistreptococcic serum may also be utilized, and it may do good in cases which have not progressed too far.

I. Ulcers due to Traumatism or to Non-specific Pyogenic Bacteria

Clinical History.—Every ulcer of this class tends sooner or later to recovery, and so may be said to pass through three stages, viz., (1) that of ulceration proper, or extension; (2) a stage of transition, or preparation for healing, which may be short or long, according to whether the ulcer is running a rapid or a slow course, and persists until the surface is covered with granulations; and (3) the stage of healing or repair. It must be clearly understood that the first stage alone represents the true ulcerative process; when this ceases, the ulcer proper disappears, and merely a superficial loss of substance, the result of the preceding ulceration, remains. If every simple ulcer passes through these three stages, then *every variety of simple ulcer must necessarily be in one of the three stages*, and hence may be described as a modification of a typical condition representing the stage to which it belongs. Naturally, in a large ulcer the three stages may co-exist, or a healing ulcer may from intrinsic or extrinsic causes relapse again to the stage of tissue destruction.

Stage I. : Ulceration Proper, or Extension.—The special characteristic of this stage is that destructive changes are progressing with greater or less rapidity, and hence the ulcers may be described as inflamed, spreading, or sloughing.

Naked-eye Appearances.—*Surface*, covered with ashy gray or dirty yellow material, partly slough, partly lymph, partly breaking-down tissue; no granulations are present; the tendency to slough is most marked when the organisms are particularly virulent, or if the resistance of the tissues is much diminished; *discharge*, considerable in amount, thin, sanious, and often irritating and offensive, rarely purulent; *margins*, thickened and inflamed, and the surrounding tissues often œdematous and infiltrated; *edge*, sharply cut and well defined; the *base* of the ulcer is thickened and fixed to the underlying structures.

Microscopically, all the phenomena of inflammation may be observed progressing to thrombosis and tissue necrosis, so that in approaching the surface from the healthy tissues one would pass through zones of active hyperæmia, of retarded blood-flow with infiltration of leucocytes and plasma, of stasis and thrombosis, whilst the tissues are in a state of coagulation-necrosis.

Treatment of First Stage.—This resolves itself into removing the cause, protecting the surface from all sources of mechanical irritation, and purifying it from all septic contamination. The inflamed part must be kept at rest, and if necessary raised from a dependent position (*i.e.*, the leg must not be allowed to hang down), whilst the sore is dressed with moist and warm antiseptic applications, such as a boracic poultice. When the parts are very offensive, a charcoal and linseed-meal poultice may be first employed. The state of the bowels and constitution must be attended to, and probably a mild purgative will be needed.

formed granulations: the *edges* are hard and sharply cut, and elevated considerably above the surface, whilst the skin around may be heaped up over the edge, and either covered with sodden cuticle or congested. The skin of the limb is often deeply pigmented from chronic congestion, the pigmentation starting in the separate papillæ as maculæ, which gradually coalesce. The *discharge* is purulent or serous, and may be so abundant and irritating as to cause eczema of the parts around, and thus give rise to one form of *eczematous ulcer*. The *base* is adherent to the underlying tissues, fasciæ, etc.; and this constitutes one of the main difficulties in healing, as contraction of the sore is thus prevented. If the ulcer extends to the periosteum, as happens not unfrequently when placed over the shin, chronic periostitis, or even osteitis, results, and a subperiosteal node is formed, corresponding exactly to the size and situation of the ulcer, forming a mushroom-shaped projection, and possibly going on to necrosis, or to enlargement of the whole bone. In some very chronic cases the superficial lymphatics and veins are so much compressed as to cause chronic œdema of the foot, often of a very solid, brawny type, and the limb may even pass into a condition of pseud-elephantiasis, preceded perhaps by recurring attacks of lymphangitis.

The so-called **Irritable Ulcer** is usually met with in this stage. Its chief peculiarities are the position, generally in the neighbourhood of the ankle, and the pain which accompanies it. The surface of a healing or chronic ulcer can usually be touched without the patient complaining; but in this variety the pain is excessive, especially at night. It was pointed out by the late Mr. Hilton that, if a probe is run lightly over the surface of such a sore, one or more spots will be indicated as the chief seats of the pain, the rest being insensitive. In all probability, nerve filaments are there exposed, as the pain has a very marked burning or shooting character.

The **Varicose Ulcer** occurs in the leg of a patient who is the subject of aggravated varicose veins. The skin becomes passively congested, and its nutrition is consequently impaired; any injury or abrasion, which would readily heal in a sound limb, is likely under such circumstances to give rise to a chronic sore. Again, it may be preceded by eczema resulting from the irritation of dirt or the friction of hard trousers, whilst occasionally it may be due to the yielding of the thinned skin which forms the only covering of a much dilated vein, an accident often leading to severe hæmorrhage. The characters of a varicose ulcer vary considerably, but in the main correspond to those of the second or transitional period; it is usually found on the inner and lower portion of the leg, whilst syphilitic sores are more often placed nearer the knee and on the outer side.

The **Treatment** of ulcers in this stage differs according to the conditions present. If it is merely a passing phase in the progress of an ulcer tending rapidly to repair, all that is needed is to continue the same course of treatment as was adopted at an earlier period of the case, viz., rest and protection from irritation. It may be

advisable to shield the surface from contact with dressings by the intervention of a small portion of purified 'protective'—*i.e.*, oiled silk coated with dextrin—so that the reparative material may not be damaged during their removal.

The **Chronic Ulcer** needs much care in its treatment, and some cases require operative interference. Rest in a more or less elevated position is absolutely essential in order to relieve the congested condition of the limb; whilst if the surface is foul, a charcoal poultice may be beneficial, or the sore may be dusted over with iodoform, and boracic fomentations applied. This may be preceded in some cases by touching the surface with nitrate of silver, or with a solution of chloride of zinc (40 grains to 1 ounce).

Pressure has been found of considerable service in the treatment of these ulcers; an ordinary bandage, reaching from the toes to the knee, will suffice in some cases, a suitable dressing of boric acid ointment, with perhaps some resin ointment added to make it more stimulating, being applied beneath it. *Martin's* indiarubber *bandage* is more useful when the veins are much enlarged.

The method of dealing with chronic ulcers suggested by Professor Unna, of Hamburg, has given excellent results. It consists in the use of an adhesive plaster, made up as follows: Gelatin, 5 parts; oxide of zinc, 5 parts; boric acid, 1 part; glycerine, 8 parts; water, 6 parts; to this ichthyol (5 per cent.) may be added with advantage. The limb is first thoroughly washed with soap and water, and purified with carbolic or sublimate lotion. It is then wrapped round with a single layer of antiseptic gauze, and the paste, liquefied by placing it in a gallipot in a saucepan of boiling water, is applied over it with a paint or paste brush. Another layer of gauze is placed over the paste and a thin bandage over all, and the whole allowed to dry. Where there is much varicosity of the veins, the paste should extend from the ankle to the knee, the foot being also included in some cases. If there is much discharge, the ulcer should not be covered, or the dressing should be reapplied in a day or two; but after it has diminished in amount, the paste may be carried right over the sore, and the whole application left in position for a week, or even longer.

When the edges are very indurated and thickened, and all action is at a standstill, Syme's suggestion may be followed, viz., the whole surface, as well as the surrounding skin, is blistered, and then a suitable dressing applied. A more satisfactory method, but requiring an anæsthetic, is to thoroughly scrape the surface with a sharp spoon, and then to rub in a strong solution of chloride of zinc. As soon as healthy action is established, skin-grafting may be employed, if necessary; it is useless to undertake this, however, unless the patient can promise to rest up for a prolonged period, and even then elastic support will be subsequently required. In bad cases where a considerable portion of the circumference of the limb is involved, when the ulcer is very callous and its base attached to the tibia, causing severe pain at night from chronic periostitis, and especially

when the patient is unable to indulge in much rest, *amputation* may be the best treatment. It will often be found that Farabœuf's amputation at the site of election can be undertaken with advantage.

Where varicose veins exist, treatment is of little avail unless these are efficiently dealt with either by operation or by some suitable support, such as Unna's paste. If operation is needed, it is often undesirable to attack the veins locally owing to the septic condition of the ulcer. It may suffice to perform a Trendelenburg's operation (*q.v.*), or to make a circular or semicircular incision round the leg at the level of thega rter, and dissect away all the superficial veins that can be reached through it.

The **Irritable Ulcer** may be treated by discovering the painful spots, and incising the tissues just above them with a knife, so as to divide the exposed nerves; but thorough scraping under an anæsthetic is preferable.

The **Eczematous Ulcer** must be dealt with differently from the others, or the eczema will be aggravated. Soothing applications are needed, such as lead lotion, and when once the acute stage has passed, tarry preparations (liq. carbonis detergens, 1 ounce to 1 pint of lotio plumbi), or an ichthyol ointment (5-10 per cent.), may be beneficially employed. A mixture of benzoate of zinc and boric acid ointments is a very useful application, or Unna's paste with ichthyol may be utilized.

Stage III.: Repair having now been fully established, we have to deal with, not a healthy ulcer, for such a condition cannot exist, but a healthy granulating wound, the result of ulceration, or, as we call it, to avoid confusion, a 'healing ulcer.'

A **Healing Ulcer** is characterized by the following conditions: *Surface*, smooth and even, shelving gradually from the skin, and covered with healthy granulations; these present a florid red appearance, are painless, and bleed, but not readily, on being touched. The *discharge* varies according to the plan of treatment adopted: if the surface is kept at rest and free from all irritants, either septic or antiseptic, the discharge is merely serous; but should the wound become septic, or be dressed with irritating antiseptics, ordinary pus is formed. The surrounding skin is soft, flexible, and free from inflammatory congestion, and the *base* is similarly free from fixity. The *margins* present a healing edge, which has been described as manifesting three coloured zones: within is a *red* area consisting of granulation tissue, covered by a single layer of epithelial cells which cannot be seen except in a good light; next comes a thin dusky purple or *blue* line, where the granulations are covered by a few layers of epithelium, and the circulation is becoming retarded owing to cicatricial development; whilst outside is a *white* zone due to the heaping up of sodden cuticle upon the healthy or healed part.

The method of repair in such a wound consists in a change of the deeper layer of granulations into fibro-cicatricial tissue, which gradually contracts and is finally covered with epithelium. For full description see Chapter IX.

surface previously denuded of all granulations. The ulcerated surface is first scraped, and the resulting hæmorrhage stayed by pressure with a sponge, a layer of protective being, however, interposed, so that when the sponge is subsequently removed the bleeding shall not recur. The strips of cuticle are then cut, care being taken to make them as thin as possible; the papillæ are always encroached on, however, and hence some amount of blood escapes, in which the grafts are allowed to remain soaking until required for use. When it is thought that sufficient material has been obtained, the sponge and protective are removed, and the grafts gently transferred, being applied in such a way that they overlap each other and also the margins of the defect. There is always some tendency for the edges of the graft to turn in, and this must be prevented. They are then covered with protective, or preferably with perforated tin or thin silver-foil, and the whole dressed antiseptically. There is usually no need to look at the wound for some days. The outer sides of the thigh and arm are the best places from which to take the grafts. By this method subsequent contraction is to a large extent prevented.

3. The whole thickness of the skin is used in some instances. Thus, the preputial tissue removed in circumcision is most valuable for this purpose, being soft and flexible. All redundant and fatty tissue must be removed, and *only* the skin applied. The granulations should always be previously scraped away, and the graft stitched down to the underlying cicatricial tissue with fine catgut. It may also be applied to the raw surface of an operation wound.

II. Ulcers due to Specific Bacteria.

The different forms of infective ulcers met with in surgical practice will be described under the appropriate headings in different parts of the book. It will suffice here to mention them:

Soft Chancre (p. 136).—This may be taken as a type of all infective ulcers, clearly showing the stages of infection, incubation, ulceration, and repair.

Ulcers due to Syphilis.

(*a*) The primary sore (p. 139).

(*b*) Secondary ulcers, mainly of mucous membranes, but sometimes involving the skin, and due to the breaking down of so-called tubercular syphilides (p. 143).

(*c*) Intermediate, rupial, or ecthymatous sores (p. 146).

(*d*) Tertiary ulcers from the disintegration of gummata, either superficial and multiple, or deep and single (p. 148).

In inherited syphilis, any or all of the above varieties may be seen, except the primary sore.

Phagedenic ulceration (p. 141) is usually associated with syphilis, but whether the phagedena is itself due to a specific organism is a little doubtful.

Ulcers due to Tubercle:

(*a*) The lupoid ulcer, due to a cutaneous tuberculosis (Chapter XVI.), or

(*b*) The tuberculous ulcer, arising as a rule from the bursting of a subcutaneous or submucous tuberculous abscess (p. 164).

(*c*) Various other tuberculous ulcerative lesions of the skin are described by dermatologists under the title 'scrofulodermia,' whilst Bazin's disease (or erythema induratum) is possibly tuberculous in origin.

Malignant Pustule, due to the *Bacillus anthracis* (p. 127).

III. Malignant Ulcers.

These are due, as has already been pointed out, not to any inflammatory process, but to the actual replacement of the skin by the growth, so that loss of substance necessarily ensues. It is only requisite to mention the varieties here; a fuller description will be appended later (Chapter VIII.):

(*a*) Rodent ulcer, a chronic cancer starting in the sebaceous glands or hair follicles, and accompanied with very little overgrowth.

(*b*) Epitheliomatous ulcer, arising from cancer of the skin or mucous membranes.

(*c*) Scirrhous ulcer, resulting from destruction of the skin over a scirrhous tumour.

(*d*) Fungating ulcer, where a neoplastic growth protrudes from the skin. It may be caused by a soft encephaloid cancer, or a sarcoma, whilst a cysto adenoma mammæ gives rise to a similar appearance. It constitutes the condition formerly known as a 'fungus hæmatodes.'

CHAPTER VI.

GANGRENE.

By gangrene, or necrosis, is meant the simultaneous loss of vitality of a considerable area of tissue. If the process is limited to the soft parts of the body, it is often termed *sloughing* or *sphacelation*, and the dead mass a *slough* or *sphacelus;* if a tangible portion of bone dies, the necrosed mass is called a *sequestrum;* while the term *gangrene* is more especially applied to a necrotic process affecting simultaneously the hard and soft tissues of a limb.

General History of a Case of Gangrene.

Signs of Death.—Death of a limited portion of the body can be recognised prior to the supervention of evident post-mortem changes within it by five characteristic signs:

1. Loss of pulsation in the vessels.
2. Loss of heat, since no warm blood is brought to it.
3. Loss of sensation, although much pain may be experienced whilst death is occurring, and such may be referred to the dead part through irritation of the nerves above.
4. Loss of function of the gangrenous mass, which, if it is a limb, lies flaccid and motionless.
5. Change of colour, the character of which depends on the amount of blood in the part at the time of death; if the limb is full of blood, it becomes purple and mottled; if anæmic, a waxy or cream colour results.

These five signs may be in measure present when the vitality of a limb is seriously depressed, as by ligature of the main vessel or by its embolic obstruction; but if they continue for any length of time, death is practically certain to ensue, and they will then be rendered more obvious by the phenomena about to be described. Sometimes it is a little difficult to determine whether a part is dead, especially when it is engorged with venous blood and the arterial pulsation has ceased; if living, it will usually be found that pressure causes some modification of the colour, and that the discoloration returns when the pressure is removed.

Changes occurring in the Dead Tissues.—The character of these changes depends mainly on the condition of affairs at the time of

Septic or Putrid Moist Gangrene (Fig. 12) is necessarily associated with a rapid breaking-up and disintegration of the mass, which becomes black, green, or yellow. The cuticle is raised from the cutis vera by blebs containing stinking serum, or even bubbles of gas, and these can be readily pressed along under the epidermis for some distance. The tissues of the limb are soft and lacerable, and on grasping it emphysematous crackling is usually noted.

The **Later History** of a gangrenous mass depends entirely on its asepticity or not, and on its bulk.

(*a*) If the necrotic area is small in size and aseptic, it may, under favourable circumstances, be entirely *absorbed* in the same way as is a catgut ligature. Such is often observed after sloughing of small portions of amputation flaps; if the part is kept dry and aseptic, it is gradually removed, and when the process is completed, a small dark scab will fall or be picked off, and a cicatrix be found beneath it. In a similar way dead bone may be absorbed, if the sequestrum is not too large or too dense, and if it is in close proximity to healthy

FIG. 12.—SEPTIC MOIST GANGRENE OF LEG FROM PENETRATING WOUND OF FEMORAL ARTERY.

vascular tissue. The dead portion is first invaded by leucocytes from the lymphatic spaces or vessels of the immediately contiguous living tissues, and infiltrated by them and the accompanying blood plasma. By a process of auto-digestion this infiltrated portion disappears, and is replaced by granulation tissue (for the origin of which, see Chapter IX.), which in turn is converted into a cicatrix, and covered with cuticle in the usual way.

(*b*) If the mass, though aseptic, is of such a size, or consists of such tissues, as to prevent its total absorption, or if the vital activity of the patient is lowered, a modification of the same process results in *partial absorption* of the dead material, *whilst the remainder is cast off and separated by a simple process of anæmic ulceration.* The dead part immediately contiguous to the living is removed and replaced by granulation tissue, and this change continues advancing into the mass until the layer of granulations which has penetrated furthest is at such a distance from its nutritive basis as to be unable to derive from it sufficient pabulum, owing to the contraction of the cicatricial tissue which is forming behind; and then a simple ulcerative process

(*b*) Those conditions depending on the presence and connection with the body of the dead tissue. Various forms of septic poisoning result, usually causing fever, asthenic in type and variable in amount. Pain, moreover, is frequently a prominent feature in some forms of gangrene, and the patient is liable to become exhausted from this cause, even though he is protected by the surgeon's care from the dangers of sepsis.

The **Treatment** of gangrene naturally divides itself into the local and general. We shall not discuss the question of **Local** treatment at this place, leaving it to be dealt with under the appropriate headings hereafter. As to **General** treatment, but little need be said beyond that the strength of the patient must be maintained by plenty of easily assimilable food, sufficient stimulant, and tonics. Pain and sleeplessness must be combated by the administration of a suitable amount of opium or morphia, if the kidneys are healthy. Diabetes and albuminuria need dietetic and therapeutic measures in order to limit, if possible, the excretion of sugar and albumen.

Varieties of Gangrene.

The following classification is one which, though admittedly imperfect, does in a measure group together allied types of the affection, and will serve as a useful one for practical purposes:

I. **Symptomatic Gangrene**, or that predisposed to by preceding vascular or general conditions, where a trauma, if present at all, is of very slight significance.

(*a*) Gangrene from embolus.
(*b*) Senile gangrene.
(*c*) Gangrene from arterial thrombosis (non-senile).
(*d*) Diabetic gangrene.
(*e*) Raynaud's disease.
(*f*) Gangrene due to ergot.

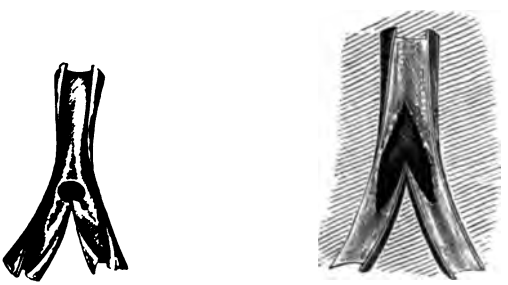
II. **Traumatic Gangrene**, which may be due to direct or indirect injury, and where the damage done to the vessels or tissues by the trauma is the immediate cause of the loss of vitality. Two varieties of this may be met with, viz.:

(*a*) The indirect, where the lesion involves the vessels of the limb perhaps some distance above the spot where the gangrene occurs.
(*b*) The direct, where the gangrenous process is limited to the part injured.

III. **Infective Gangrene**, which arises from the activity and influence of micro-organisms.

(*a*) Acute inflammatory or spreading traumatic gangrene.
(*b*) Wound phagedena and hospital gangrene.
(*c*) Necrosis of bone (most cases).
(*d*) Noma and cancrum oris.
(*e*) Carbuncle and boil.

The chief early **Symptom** is pain experienced both at the point of impaction and also down the limb along the course of the vessel. Pulsation below the block ceases, sensation and temperature diminish, and the part feels heavy and useless. If the vessels are healthy, stagnation of blood in the veins is an early result, the terminal portion of the limb becoming congested and œdematous, and finally passing into a condition of moist gangrene. If, however, the terminal arteries are calcified or atheromatous, so that the limb is in a state of chronic anæmia, dry gangrene is likely to follow. The process starts peripherally, and spreads gradually upwards until it reaches a level where there is sufficient circulation to maintain the life of the part. Such usually obtains in the neighbourhood of a joint, since there is always a more free anastomosis here than in the interarticular portions of the limb; thus, in the leg the gangrene is arrested either



A B

FIG. 14.—DIAGRAMS OF EMBOLUS SADDLING THE BIFURCATION OF AN ARTERY.

In A the embolus is seen, and the commencement of a thrombus on it, but not yet obstructing the vessel; in B both branches of the trunk are blocked by the growth of the clot.

immediately above the ankle or below the knee. The subsequent history depends upon whether or not the dead tissue is allowed to become septic, and requires no special notice.

Treatment.—The all-important requisite is to prevent the advent of sepsis, even before any absolute signs of death are manifest. The nails should be cut, and the whole limb thoroughly purified (Chapter X.), special attention being directed to the intervals between the toes and the semilunar folds of the nails. It should then be wrapped in a sterilized dressing, and lightly, though firmly, bandaged. The limb is kept slightly raised so as to assist the venous return without interfering with the arterial supply, and by this means gangrene may be prevented. If, however, gangrene ensues, the same measures as to the maintenance of asepsis must be continued until a natural line of separation forms. In old people with dry gangrene similar rules are followed as for the senile type; but in the moist form, occurring in young people, the natural process of separation may be hastened by severing the dead from the living and sawing through the bone, or

inflammatory phenomena, the toes merely shrivelling up and dying (*non-inflammatory senile gangrene*). The inner side of the great-toe is perhaps the commonest situation for the mischief to start, and thence it spreads from one toe to another, and also along the instep and up the ankle to the leg. Pain is always a marked feature, whilst the extent of the gangrene is dependent partly on the amount of general and local vitality, and partly on the asepticity or not of the surrounding tissues. As the disease spreads, the patient becomes exhausted by the long-continued pain and want of sleep; and septic fever, bedsores, or the intervention of some cardiac, pulmonary, or renal complication, may also hasten a fatal termination.

The **Treatment** adopted until recently was governed by the observation that after any attempt to amputate through *neighbouring* living parts the gangrenous process is certain to commence again in the flaps; if merely cutting a corn suffices to originate the malady, much more does so severe an injury as an amputation. The parts were dusted with iodoform or some similar antiseptic, and wrapped in cotton-wool to keep them warm; the surgeon waited for a line of separation, and even then merely assisted Nature by dividing tendons or bones. The general health was maintained by suitable nourishment, stimulants and tonics, and pain alleviated by opium. In spite of every care, however, the enfeebled constitution of the patient was often unequal to the task of ridding the body of the dead mass, so that death from exhaustion or blood-poisoning was the rule rather than the exception; and even if he did recover, the prolonged illness considerably diminished his vital powers.

It has now, however, been clearly demonstrated that *early amputation well away from the dead mass* at a point where the blood-supply is sufficient to nourish the flaps, and yet not so near the trunk as to seriously threaten life through shock, holds out the best prospects of relief. In order to determine the most favourable site, the pulsation in the main artery should be felt for, and if feasible no operation performed at a spot where it appears to be occluded. The condition of the limb will also influence the surgeon's decision; if thin, attenuated, and shrivelled, it will be wise to amputate high; but if the limb is fairly well nourished and with plenty of adipose tissue, the operation may be performed somewhat lower. In operating, as little damage as possible should be inflicted on the parts, the flaps being nearly equal in length and not too flimsy, a circular amputation, or some slight modification of it, being perhaps the best. In cases where the mischief is limited to the foot, it is usually advisable to amputate through the lower third of the thigh, or at any rate in the neighbourhood of the knee-joint, though not through the joint itself, as the flaps in that operation are always rather flimsy. We have followed this line of practice for some years, and have no reason to be dissatisfied with our results. Dissection of the portions removed has always shown that the vascular trouble was fully as advanced as we had anticipated, and that no minor measures would have sufficed.

(c) **Gangrene from Arterial Thrombosis (non-senile)** is not a common occurrence. It arises as a result of that curious affection *endarteritis obliterans*, and also develops in some young people in scattered patches about the skin without any of the characteristic phenomena of Raynaud's disease. It sometimes occurs in connection with typhoid fever and other conditions of severe toxæmia as an outcome partly of the increased coagulability of the blood, partly of a localized endarteritis, due to the toxins present in it. The femoral artery is most usually blocked, but occasionally the trouble will spread up to the aorta and involve both legs in the gangrenous process. Unless the vein is also involved, the gangrene is usually of the dry type. It is wise to wait until a line of demarcation has formed, and then amputate well above.

(d) **Diabetic Gangrene** is mainly due to the abnormal condition of the blood in diabetes, thereby reducing the power of the tissues to

FIG. 15.—DIABETIC CELLULITIS AND GANGRENE OF FOOT.

resist bacterial invasion; but it is also in measure the result of a sclerosing endarteritis and peripheral neuritis. It is not commonly met with in the subjects of acute diabetes, nor, as a rule, in people below forty years of age. It results usually from some slight traumatic or infective injury, and often commences on the under side or at the extremity of one of the toes as a bleb, surrounded by a dusky purple areola. When the bleb is opened or bursts, the central portion of the underlying tissue is found to be necrotic, and from this focus the gangrene spreads. If the part is kept aseptic, and especially in limbs with some degree of endarteritis, the dead part may shrivel and dry up, especially when suitable dietetic restrictions are enforced; but if such local and general precautions are not observed, extensive suppurative infiltration of the soft parts may follow (Fig. 15), even though the necrotic process itself be of slight extent, and from this the patient may succumb, the fatal issue being due partly to diabetes, partly to toxæmia, and being often preceded by coma.

Treatment.—In the less severe cases, limited to one or more toes, it will often suffice to keep the part warm and aseptic, until it is

separated by natural processes, or at any rate the surgeon merely completes the work by dividing or dissecting out bones. Naturally, the elimination of sugar must be checked, if possible, by suitable diet and the administration of codeia. In more extensive trouble the character of the treatment turns largely on the amount of vascular disease and the degree of the accompanying inflammation. If the vessels are tolerably healthy, amputation not very much above the upper limit of the gangrene is justifiable; but if the main trunks are probably affected, a high amputation will be required, if the patient's general condition permits, although there is some risk that diabetic coma may supervene. When extensive suppuration is present, it is sometimes wise to lay the parts open for awhile and drain away the inflammatory exudations before considering the question of radical treatment.

(*e*) **Raynaud's Disease**, or **Spontaneous Symmetrical Gangrene**, is a condition usually met with in anæmic or neurotic young women between the ages of fifteen and thirty. It is due to vaso-motor spasm, dependent on some deep unrecognised lesion of the spinal cord, or in some cases to a peripheral neuritis. Three stages are usually described: (i.) local syncope or anæmia, due to arterial spasm, and characterized by pallor and painfulness of the part; (ii.) local asphyxia or congestion, the affected tissues being blue and cyanosed from venous regurgitation; and (iii.) necrosis, the part becoming dry and black. The onset is often sudden, and the disease may last for a variable time, from days to months. If gangrene supervenes, the latter is the limit more often reached; but it by no means necessarily follows that tissue necrosis occurs in every case. The disease is usually symmetrical, and affects the fingers rather than the toes, but superficial patches may occur on any part of the body; the process is non-febrile and often very painful. Paroxysmal hæmoglobinuria has been observed, and is supposed to be due to vaso-motor disturbance of the kidneys. Ankylosis of the smaller interphalangeal joints and localized patches of anæsthesia, associated with neuralgic pain, are sometimes present, resulting from peripheral neuritis. The condition resembles the later stages of a chilblain, but is distinguished by its more dusky colour, the greater pain. the absence of itching, and the fact that the process is not limited to exposed or terminal parts, or to cold weather.

The **Treatment** in the early stages is directed to the prevention of gangrene. Iron, quinine, and other suitable tonics are administered, and menstrual irregularities are attended to. Friction with stimulating embrocations, warm douches, and protection from cold and injury, may be employed locally, but probably the best results will follow the use of electricity. The constant current is employed, and preferably in the shape of the electric bath, local or general as required, and repeated either once or several times a day. When actual gangrene is present, the dead tissue should be kept aseptic, when sooner or later it will be absorbed or separated.

(*f*) **Gangrene from Ergot** is a rare phenomenon, but it has been

known to occur when diseased rye has been used in the manufacture of bread. The resulting gangrene may vary in extent from the loss of one or two fingers or toes to the sacrifice of the greater portion of one or more limbs.

II. Traumatic Gangrene.

By traumatic gangrene is meant the loss of vitality of some part of the body as the consequence of an injury, whether applied to the main bloodvessels (*indirect* traumatic gangrene), or directly to the tissues (*direct* traumatic gangrene).

(a) **Indirect Traumatic Gangrene** arises from a considerable variety of lesions, and the course and clinical history are similarly variable.

(i.) **Ligature of the main artery** does not produce gangrene in a healthy limb; but should it be in a state of chronic malnutrition and anæmia from preceding arterial disease, death of a certain portion may ensue, the case running a similar course to one of gangrene due to embolus. It is usually of the dry type, and limited to one or two toes; but if it reaches the more fleshy portions, the moist variety supervenes.

Treatment consists in keeping the parts warm and aseptic until a definite line of separation forms, and then in assisting the natural processes at this spot by dividing tendons and bones. If, however, a considerable area of the limb loses its vitality, and especially if the dead tissue is moist and septic, an early high amputation is required.

(ii.) **Arterial thrombosis from injury** only causes gangrene under special circumstances, the course and treatment being similar to that resulting from an embolus.

(iii.) **Obstruction to both main artery and vein** is an almost certain precursor of gangrene. A few cases are on record in which both vessels have been ligatured, or even portions of them removed without such a result, as in dealing with cancerous deposits in the axilla or in the extirpation of aneurisms; but in both these instances obstruction to the circulation must have previously existed, necessitating the opening up of collateral anastomotic branches. In a normal limb the occlusion of both afferent and efferent trunks is practically sure to determine tissue necrosis. It may therefore be caused by the inclusion of both vessels in a ligature, or by the *strangulation* of organs, either within the body, as in a strangulated hernia, or outside of it, as when a ligature is tied round the base of the penis, or a bandage applied too tightly round a fractured limb. It may even result from the swelling of a limb under a bandage which has been originally applied with no undue tension.

A very similar effect may be produced by the excessive hyperæmia and exudation following the sudden relief of a tight constriction around a part, which has thus been deprived of fresh arterial blood for some time; the vessel walls are thereby so damaged that they are unable to resist the blood-pressure, and the exudation that follows is so abundant as to rapidly bring the circulation to a stand-

still. Such an occurrence is met with after frost-bite, and also in a loop of bowel after strangulation.

Gangrene may also result from the rupture of a main artery and compression of the accompanying vein by the extravasated blood, an occurrence perhaps most frequently seen after *fractures* and *dislocations;* it is then always of the moist type. (See Chapter XIX.).

Treatment varies considerably in these cases. If the parts are hopelessly injured, amputation should be performed at once, so as to prevent the risk of sepsis. In some fractures and dislocations with vascular lesions, it may be possible to save the limb by cutting down, turning out clots, and securing the injured vessels, whilst the bony lesion is dealt with in a suitable manner. The limb should afterwards be elevated slightly, and the peripheral segment kept warm and aseptic. Should gangrene supervene, amputation will be required, its situation depending on the character of the local lesion; if it is not of a serious nature—*e.g.*, a clean fracture or simple dislocation—it is wise to wait for a line of demarcation; but if comminution of bone or other grave local trouble is present, one would amputate above the injury.

(*b*) **Direct Traumatic Gangrene**, or that resulting from the immediate effect of injury to the parts, is similarly due to a variety of lesions.

(i.) **Severe crushes or blows** are a common cause of this type of gangrene; thus a limb may become mangled between the wheels of machinery, or by heavy weights falling on it, or by the passage of vehicles over it. Not only are the parts crushed, severely contused, or even 'pulped,' but the bloodvessels may be torn, and the resulting extravasation contributes to the result. The gangrene is of the moist type, and is more likely to supervene in patients whose vitality is diminished. Thus, a crush of the foot in an elderly person is often followed by it, when in a young and healthy adult it could be prevented.

Treatment.—If the part is hopelessly damaged, operation should not be delayed on account of the dangers of sepsis; and therefore immediate amputation is recommended. The question of shock and its influence in determining operation is discussed elsewhere. When there seems a reasonable chance of saving the limb, it is cleansed and purified under the strictest antiseptic precautions; should gangrene supervene, it may be removed later.

(ii.) **Prolonged pressure** is also capable of producing gangrene. Gangrene from *splint pressure* is either almost unavoidable, or the result of carelessness. When the fragments are much displaced after a fracture, considerable pressure may be required to retain them in good position, and then in spite of every precaution necrosis may ensue. Pain of a neuralgic type is usually complained of for a few days, but even that is not necessarily severe enough to attract much attention; when the limb is freed later on, the dead portion of the skin is white, anæmic, and insensitive. The necrotic process may extend to some depth, and hence the greatest care must be

III. Specific or Infective Gangrene.

(*a*) **Acute Spreading, Acute Emphysematous,** or **Spreading Traumatic Gangrene.**—This disease is one of the most rapidly fatal and serious met with in surgery.

Causes.—(i.) The *individual* attacked is often predisposed to infection as a result of vicious or careless living, heavy drinking, or simple malnutrition; but even healthy individuals may be attacked if the virus is particularly active. It is sometimes seen in diabetics, but an apparent glycosuria occasionally develops in the course of the disease.

(ii.) The causative *lesion* is usually severe, such as a compound fracture or dislocation, especially if the soft parts are much contused or very dirty. Less frequently it consists of small and insignificant pricks, scratches, or abrasions, if thereby a virulent organism gains access to the tissues. In this way post-mortem porters, nurses, or pathological demonstrators may become infected.

(iii.) An organism frequently present is the *Bacillus œdematis maligni*, which is identical with the *Vibrion septique* of Pasteur and the French writers. It is a rod-shaped organism, which closely resembles that of anthrax, but with a greater tendency to grow into long threads. It is actively motile, and forms oval spores, which may be placed at the centre or at the end of the rod. It does not stain by Gram's method. Cultures only develop under anaërobic conditions; and if the culture medium contains glucose, a large amount of foul-smelling gas is produced. It is usually very virulent for mice and guinea-pigs, which die within twenty-four hours of inoculation; locally a spreading œdema is produced, the connective-tissue spaces being filled with fluid containing bacilli, and perhaps air-bubbles. Bacilli are also found in the exudations which occur in the serous cavities, in the connective tissues of important organs, and in the blood for some time after death. The *B. aerogenes capsulatus* may also cause acute spreading gangrene. It is an anaërobe with a similar power of fermenting sugar, but it differs from the bacillus of malignant œdema in that it is non-motile, rarely forms spores, and retains Gram's stain. It usually forms a well-defined capsule, from which its name is derived; this, however, is not invariable. Careful investigation of fifty-eight cases* of spreading gangrene demonstrated that in only fourteen cases was the infection pure, and that with an anaërobic organism; in forty-four cases the infection was mixed, various septic organisms being present in addition to the gas-producing microbe, which was more frequently the *B. aerogenes capsulatus* than the *B. œdematis maligni*. A special feature of infection with the former is the large amount of gas produced, not only in the tissues, but also post-mortem in the

* See Corner and Singer on 'Emphysematous Gangrene,' *Trans. Path. Soc. Lond.*, vol. lii., 1901, p. 42; Welch's 'Shattuck Lecture,' *Philadelphia Med. Journ.*, August 4, 1900.

vessels, and notably in the liver, from which it can easily be squeezed, constituting the 'foaming liver' of some writers.

The **Symptoms** are those of a hyperacute cellulitis, accompanied by general septicæmia. The wound early takes on an unhealthy action, the surface becoming covered with sloughs, and a thin serous or sero-sanguineous discharge escaping. The inflammatory process rapidly spreads along the connective-tissue planes of the limb, which becomes swollen, painful, and brawny. At first it is of a dusky purplish colour, but soon the signs of actual gangrene supervene, and the necrotic tissues become crepitant and emphysematous, partly from simple putrefaction, partly from the gaseous developments associated with the growth of the specific organism. Occasionally the emphysema spreads widely and rapidly, with at first no other local evidence of mischief; sloughing will, however, follow if the patient live long enough. Evidences of profound toxic disturbance, such as hyperpyrexia and delirium, soon manifest themselves; but not uncommonly fever may be entirely absent, the temperature being subnormal and coma present. The outlook is exceedingly grave, death usually ensuing in from five to seven days after the onset.

The only **Treatment** which holds out any hope in dealing with a limb where the disease is rapidly extending is a high amputation, even through the shoulder or hip-joint. Any delay is dangerous, although, in spite of the greatest promptitude, the infection may have progressed so rapidly that death follows from septicæmia, even after the limb has been removed. Perhaps it may be wise to leave the wound widely open for a day or two so as to permit the free discharge of secretions. In a few cases, where the patient is seen early, it has been possible to save both life and limb by freely incising the affected tissues, and immersing them in a continuous warm antiseptic bath. At the same time the general health must be attended to by giving plenty of fluid nourishment, together with diffusible stimulants, such as ether and ammonia.

(*e*) **Wound Phagedena** and **Hospital Gangrene** were seen often enough in the pre-antiseptic era, but are now practically unknown. They consisted in a rapidly spreading ulceration or gangrene, which attacked operation wounds a few days after their infliction, and as a rule led to rapid death.

(*f*) **Necrosis of Bone** is almost always due to the development of organisms, and may be either acute or chronic. In the former, the inflammatory reaction is so severe that the vessels are strangled within the bony alveoli; in the latter, it is largely due to an obliterative endarteritis, which accompanies the various specific processes. (See Chapter XX.)

(*g*) **Cancrum Oris** and **Noma**. **Cancrum oris** is an infective gangrenous stomatitis, affecting young children living in squalid surroundings in over-populated districts of large cities. The patients are always in a low state of health, and frequently convalescing from one of the exanthemata, particularly measles. Various special

organisms have been described from time to time as responsible for cancrum oris; but it appears that any of the many forms found in the mouth may be present, and probably the *Streptococcus pyogenes* acting in conjunction with various saprophytic bacilli is the most important. The process starts in an abrasion of the mucous membrane, which, being infected from a diseased or dirty tooth, becomes inflamed and gangrenous. A foul ashy-gray pultaceous slough forms on the inside of one of the cheeks, and from this a most offensive discharge is poured into the mouth and swallowed, the breath in consequence becoming intensely fœtid. The gangrene gradually spreads both superficially and deeply; the cheek becomes swollen, shiny, and tense, and, should the process extend through its whole substance, a black slough appears on its outer aspect. In bad cases, the adjacent bones of the face may be affected and die, and the tongue, palate, and even the fauces, may also be involved.

The general phenomena are those of a severe sapræmia, since not only are the toxic products swallowed, but they are also absorbed by the lymphatics, and may be inhaled, in the latter case giving rise to septic pneumonia. Moreover, the patient runs a considerable risk of developing pyæmia, from implication of the facial or other veins in the necrotic process, whilst infective septicæmia may also supervene. Rigors and high fever may occur early in the case, but death is usually preceded by symptoms of collapse and coma with a subnormal temperature.

The **Treatment** must be prompt and energetic if the child's life is to be saved. The patient should be anæsthetized, and all the pultaceous slough scraped from the interior of the mouth by means of Volkmann's spoon, until healthy bleeding tissue is reached. The denuded surface is then freely rubbed over with pure carbolic or strong nitric acid. If the bones of the face are involved, they must be removed, as also any offending teeth. Afterwards the child should be well fed up, and of course for a time with fluids; the mouth is to be frequently washed out with antiseptic lotions, such as a solution of sanitas (1 in 10), boroglyceride (1 in 20), or permanganate of potash, or with a gargle of chlorate of potash (10 grains to 1 ounce). A mixture containing chlorate of potash, dilute hydrochloric acid, and infusion of cinchona, may be administered for a few days, and then iron and quinine. In the most severe cases the same treatment should be adopted, even if the whole thickness of the cheek has been encroached on; loss of substance must be made good by subsequent plastic work. Necessarily, the cicatrization following this destructive process results in a good deal of permanent impairment to the movements of the jaw.

Noma is the name given to a similar process occurring about the genital organs of children, especially the vulva. The **Treatment** is practically the same, except that here it is possible to immerse the patient in an antiseptic bath, thereby diluting the toxic products, and possibly preventing the necessity for having recourse to more serious surgical procedures.

(*e*) For **Carbuncle** and **Boil**, see Chapter XVI.

his classification may still be retained with advantage. The *first degree* consists merely in a scorch or superficial congestion of the skin, without destruction of tissue; the part may, however, remain red, painful, and prone to ulceration for a time. Should the scorch be often repeated, as by people constantly warming their legs before the fire, the skin becomes chronically pigmented and indurated (*erythema ab igne*). In the *second degree* the cuticle is raised from the cutis, and a bleb or blister results. When this bursts, and the cuticle is removed, the cutis vera, red and painful, is exposed below. In the *third degree* the cuticle is destroyed, as is also part of the cutis vera, but the tips of the interpapillary processes, including the exquisitely sensitive nerve terminals, are laid bare and left intact; consequently this is a most painful form of burn. The deeper structures of the skin—viz., the sweat and sebaceous glands, and the hair follicles—remain untouched, so that, although the surface during the healing process becomes covered with granulations, the integument is very rapidly replaced, since there are so many epithelial elements from which it can grow. The cuticle is able to form not from the edge only, as must occur wherever the whole of the cutaneous envelope is destroyed, but also from innumerable foci scattered over the wound surface. The resulting scar, though often white and visible, undergoes no contraction; it is supple and elastic from containing all the elements of the true skin. In the *fourth degree* the whole thickness of the integument is destroyed, as well as part of the subcutaneous tissues. In the *fifth* the muscles are also encroached upon, whilst in the *sixth* the whole limb is charred and disorganized. In the last three forms healing can only occur by removal of sloughs and the formation of a cicatrix, which by its contraction may lead to deformity.

The **Local History** of a burn may be described in three stages, corresponding to the three stages through which an ulcer or a lacerated wound passes: (1) The stage of destruction or burning, the various degrees of which have been just alluded to; (2) the stage of inflammation and sloughing, whereby the dead tissue is removed, and the wound converted into a healthy granulating sore; (3) the stage of repair, which follows the course described elsewhere (Chapter IX.). There are no special characteristics of these processes which call for particular note, except that they are usually of a septic nature, unless the burn is a small one. The skin is usually dirty (from a surgical standpoint) at the time of the accident; it may be infected from the clothes which are being worn, and immediate attention may be impossible. Moreover, the extent of the lesion and the terrible pain associated with it often render complete sterilization impracticable.

The **General or Constitutional Conditions** which correspond to these three stages require a little fuller notice.

1. In the early stages *shock* is usually present, and its intensity depends as much on the extent of the burn as on its depth, so that total charring of a limb may cause less depression of the system than

an extensive superficial scorch, especially if the latter involves the abdomen. It frequently passes into a condition of collapse, due in measure to the absorption of toxic products from the burnt tissues.

2. Subsequently a period of *inflammatory fever*, usually of septic origin, follows, and may last four to fourteen days. The viscera become congested, particularly the gastro-intestinal canal, liver, lungs, and brain, and various complications may result therefrom.

One of the most interesting sequelæ, though at the present day it is admittedly uncommon, is **Ulceration of the Duodenum**. Its presence is suggested by pain in the epigastrium after food, perhaps some vomiting, which may be blood-stained, and possibly the passage of a motion containing altered blood. Occasionally the first sign of such mischief is the sudden collapse of the patient, followed by death, with or without peritonitis, owing to perforation or excessive haemorrhage (Chapter XXXIV.). The bleeding generally arises from erosion of the superior pancreatico-duodenal artery. The ulcers are of the usual duodenal type, and occur close to the orifice of the bile-duct. They probably result from the elimination by the liver of some irritating substance derived from septic or other changes in the burnt tissues which is capable of inducing thrombosis, or of producing ulceration in the structures in close contiguity to the entrance of the bile-duct. In one case under observation, a post-mortem examination revealed a patch of well-marked ecchymosis in the duodenal mucosa exactly opposite the orifice of the bile-duct. Obviously it was the early stage of this condition, and would have gone on to ulceration had the patient lived.

3. When healthy repair is occurring locally, and the parts are kept aseptic, no abnormal constitutional condition should be present, although there may be a certain amount of **asthenia** or anæmia. Where, however, the wounds are septic and suppurating freely, this tendency will be much more marked, and the patient may even develop hectic fever and amyloid changes in the viscera, and finally die of exhaustion.

Causes of Death from Burns.—If an individual is burnt to death, the fatal event is usually occasioned by asphyxia from the smoke and noxious fumes of the fire; shock and syncope from fright may perhaps be adjuvants, especially if the heart is weak or diseased. Within the first few days death results from shock or collapse from toxæmia: in the second stage, from sepsis, internal complications, ulceration of the duodenum, etc.; in the third stage, from exhaustion or intercurrent maladies. The prognosis in children is always more unfavourable than in adults.

Treatment.—In superficial scorches without vesication, all that is needed is to protect the affected parts, *e.g.*, by dusting them over with boric acid powder mixed with starch, or by painting them with collodion. Blisters should be washed antiseptically and then punctured, so as to allow the contained serum to escape, and then the area should be dusted with boric acid powder, and covered with aseptic wool. Carron-oil (*i.e.*, a mixture of equal parts of linseed-

oil and lime-water) is often used, applied on lint; it is, however, not an antiseptic, although by adding a small proportion of eucalyptus-oil (1 to 10) this can be corrected. Picric acid may be used when the cutis vera has not been entirely destroyed; the vesicles are punctured, and then a piece of lint, soaked in a solution of picric acid (20 grains to 1 ounce of sterilized water), is applied to the burnt surface, and over this, in turn, a pad of salicylic or sterilized wool is bandaged. Thus a dry dressing is produced, which may be left *in situ* for some days, when it is re-applied. The results are sometimes most satisfactory.

Where the burn includes deeper structures, the clothes must be removed with as little dragging as possible, being cut away if necessary; the damaged tissues are then bathed with some antiseptic, such as sublimate lotion (1 in 2,000), and covered up as rapidly as possible with lint soaked in eucalyptus-oil or weak carbolized oil (1 in 40). In some cases, where the skin and surface are exceedingly dirty, it is well to anæsthetize the patient, cut away parts which must obviously slough, and thoroughly purify the wound, which is covered with protective and dressed with cyanide gauze or some such material.

If the patient is in a state of shock, he should be put to bed and covered with warm blankets or rugs, whilst perhaps a little warm stimulating fluid is administered; in bad cases an intravenous injection of hot saline solution is advisable, and it may often be repeated with advantage. In the case of children with very extensive burns, it is sometimes useful to put them into a hot bath, to which some eucalyptus-oil, if obtainable, has been added; the clothes are then removed or cut away, and the patient allowed to remain for some time, or until the shock has subsided, in the warm water, which should be replenished, if necessary. The wounds are then dressed, and the little patient removed to bed. It may be desirable to repeat the immersion at every dressing.

When a limb has been hopelessly charred or burnt to the bone, it is useless to retain it, and early amputation through the nearest healthy tissues should be undertaken.

During the stage of inflammation and sloughing the only requisite is to keep the parts as free from sepsis as possible, assisting the natural processes of repair by warm moist applications, and snipping away sloughs as they loosen. Subsequently the wounds are treated on general principles. The granulations often become prominent, and stimulating applications, such as touching them with lunar caustic, may be necessary. In large wounds, healing should be assisted by skin-grafting, according to Thiersch's method; unless some such proceeding is instituted, the wound is likely to become chronic, and healing may be delayed perhaps indefinitely.

renders the subject more liable to recurrence after a short period of immunity. (iii.) Bad hygienic surroundings are a most important additional factor in its production, especially overcrowding in hospitals and bad ventilation. But these are all merely predisposing conditions; the only exciting and absolute cause is (iv.) infection with the particular micro-organism. In the so-called *idiopathic* form infection occurs through some slight abrasion, or even through sound skin or mucous membrane. When once an entrance has been effected, the cocci develop in the superficial lymph channels, producing a transient local inflammation and a concurrent pyrexia from absorption of toxins.

The **Symptoms** of the disease are usually ushered in by a slight chill, scarcely amounting to a rigor, and by a period of headache and malaise for about twenty-four hours with some degree of pyrexia. These symptoms are followed by the development of a bright, rosy-red rash, spreading either from the margin of the wound, or showing itself in apparently unbroken skin in the so-called idiopathic variety. If there is a wound, it usually presents a yellowish, unhealthy-looking surface, with very little evidence of repair. If the erysipelatous virus is unmixed with other organisms, the healing process may continue until the rash appears on, about the fourth or fifth day, when the young cicatrix will break open again, exposing a dry and sluggish surface with a thickened margin; it may occur, however, at an earlier date. The *rash* is generally of a characteristic vivid red colour, disappearing on pressure, and accompanied by a sensation of stiffness or burning, scarcely amounting to pain, except when dense structures, such as the scalp, are involved, and then the pain may be very severe. Swelling is not very marked, except in lax areolar tissues, such as in the scrotum or eyelids; the œdema may then attain considerable proportions. The rash continues to advance more or less rapidly, with a continuous slightly raised margin, and as it spreads to new regions it fades away from those already involved, leaving a slight brownish stain and a fine branny desquamation. In some cases it does not spread evenly, but appears to leap over an interval, and then the intervening lymphatics are found to be thickened. Vesicles and bullæ form superficially, containing serum, which speedily becomes turbid, but suppuration is uncommon, except in lax œdematous tissue, such as the eyelids. Occasionally, from the severity of the inflammation or the low state of vitality of the tissues, the skin may become gangrenous and slough, especially about the umbilicus and genitals of young children. Neighbouring lymphatic glands are always enlarged and painful, and this may even be noted at a period when the rash has not appeared. Periphlebitis may also be caused, leading to pyæmic complications. Fever is present as long as the rash persists, and merely shows slight diurnal variations. It is not uncommon for the temperature to rise to 104° F., but anything above that is of grave significance. At first the fever is of a sthenic type, the pulse full, and the delirium noisy and active; but later on the pulse becomes quick and weak, accompanied by low, muttering

usual in ordinary sepsis, though common in erysipelas, whilst lymphatic enlargement is not constant. A patch of *cellulitis* will also be distinguished by the same features. Diffuse *erythema nodosum* is recognised by the slight degree of the febrile disturbance, and the presence of outlying patches of redness, which, moreover, are not so clearly limited. There is always considerable pain in this affection, which often involves both legs, and usually occurs in young women of a rheumatic temperament. The so-called *erythema solare* follows exposure to the sun's rays, especially when reflected from water, of parts of the body which are, as a rule, protected; though usually of slight importance, it may sometimes give rise to so much pain, œdema, and constitutional disturbance as to simulate erysipelas. It is readily distinguished by the facts that it is limited to the parts exposed and has no tendency to spread. In acute *eczema rubrum* the presence of a honey-like exudation is quite characteristic.

Pathological Anatomy.—If a person dies of erysipelas, one merely finds the general signs common to all septic cases detailed elsewhere (p. 78). The rash will have faded, but on microscopic section of the skin colonies of cocci arranged in chains will be found invading the lymphatics just beyond the spreading margin, whilst in the parts which the inflammation has recently attacked there will be a considerable excess of leucocytes, presumably connected with the destruction and removal of the cocci. The lymph glands will also be found enlarged and congested.

Prognosis.—Erysipelas is not peculiarly dangerous in itself (Osler gives the death-rate as 7 per cent. in hospital patients), but may become so from the complications which attend it. The most important of these are inflammatory conditions of the brain, lungs, and other viscera, especially of the kidneys. Pyæmia and general septic intoxication are also observed. Erysipelas is usually attended with danger to life in old people, drunkards, and infants, whose vital powers become rapidly exhausted. As a local complication, erysipelas is not always unfavourable, since chronic and sluggish wounds will sometimes manifest marvellous reparative power after an attack. Chronic lupoid and syphilitic ulcers may rapidly cicatrize, and even malignant sores, especially sarcomata, have been known to be cured.

Treatment.—Close attention to the rules of antiseptic surgery should banish erysipelas entirely from ordinary surgical work, but if the surgeon has to treat a case, or if the disease is prevalent, it is wise to be cautious and put off all operations that can safely be postponed. Single cases must be isolated, and kept out of surgical wards. If, unfortunately, a case cannot be completely isolated, the bed should be placed as far away from others as possible, and especially from those with open wounds which from their position (*e.g.*, the mouth) cannot be properly protected from sepsis. It is usual to surround the bed with sheets kept moist with carbolic lotion, and the floor around should be sprinkled with the same. Special nurses and dressers must be told off to attend to the case.

Local Treatment.—When one considers the bacterial origin of the affection, it is evident that, except in the mildest cases, the old-fashioned plan of merely protecting the part from the air, as by painting it with collodion, or covering it with a thick layer of starch or flour, mixed perhaps with boric acid, was very inefficient, whilst it is equally obvious that the local application of cold is absolutely harmful, as tending still further to depress the vitality of the part. Where tension and pain are severe, fomentations containing opium or belladonna (*e.g.*, 1 ounce of laudanum to 1 pint of lotio plumbi) may be applied, or the parts should be scarified and antiseptic compresses applied, *e.g.*, gauze soaked in carbolic acid (1 in 40) or in sublimate solution (1 in 1,000). Perhaps the best local applications are ichthyol or thiol, the latter being an artificial sulphur compound much resembling ichthyol, but without the objectionable smell. A 2 to 40 per cent. aqueous solution is painted over the affected area, possibly after scarification, as well as over the neighbouring healthy skin, several times a day until the fever disappears; such treatment is stated to be usually successful in checking the disease in two or three days, whilst the stickiness of the preparation hinders the diffusion of the virus.

Pressure may be of some value in limiting the spread of the rash, probably by compressing the lymphatics. A wide band of adhesive plaster wound around a limb beyond the margin of the rash is often effectual, and it may be possible in this way to check its advance from the scalp to the face or neck.

Anything that tends to produce a local accumulation of leucocytes in the skin beyond the spreading edge should be beneficial in checking its advance, and therefore good may be derived by painting around the rash with strong solutions of nitrate of silver or with lin. iodi, granting that it is done sufficiently far off to be on healthy skin. The most efficient plan based on this idea is Kraske's, in which the skin is scarified all round at a distance of an inch or two from the spreading margin, the knife going just deeply enough to draw blood; antiseptic compresses are then applied.

Antistreptococcic serum should be employed as early as possible, and probably acts by destroying the bacteria by a process of bacteriolysis. Ten or fifteen c.c. of this serum are given subcutaneously as a dose, and repeated once or twice a day. In favourable cases the pain rapidly diminishes, the rash ceases to spread, the temperature falls, and in twenty-four to forty-eight hours the disease may be at an end; but this result is not always obtained, possibly owing to some defect in the preparation of the serum, or to the fact that the animal from which the serum was derived was not immunized to a streptococcus of the same nature as that present in the erysipelatous lesion. To remedy this, a polyvalent serum has been introduced, which is prepared by injecting the animal with cultures of streptococci from many sources.

Constitutional Treatment must be of a tonic and supporting character. Good food, easy of assimilation, stimulants and quinine,

should be freely administered, whilst the tincture of the perchloride of iron in ½-drachm doses, repeated three or four times a day, is still looked on by many as a specific.

In *cellulo-cutaneous erysipelas* early and free incisions must be made to relieve tension, and, if possible, anticipate suppuration. The tissues, when incised, look gelatinous from the œdema present, and much fluid of a sero-purulent type will escape. If this is not undertaken, considerable portions of skin and subcutaneous tissue may slough. Antiseptic poultices should be employed after the incisions have been made, until granulations have developed.

In *erysipelas of the fauces* the parts must be painted or freely sprayed over several times a day with antiseptic lotions, such as liquor argenti nitratis (10 grains to 1 ounce), liq. hydrarg. perchlor. (1 in 2,000), or liq. sodæ chlorinatæ (1 part to 15 parts of water), whilst tracheotomy may be needed if the glottis is involved. Diffusible stimulants and plenty of nourishment are urgently necessary to combat the depressing effects of this disease.

Tetanus.

Tetanus is a local infective disease, due to the *Bacillus tetani*, and the characteristic symptoms are of a toxæmic nature.

Predisposing Causes.—1. *Climatic Influences.*—It is most commonly seen in the tropics, where it may be almost epidemic, probably owing to the heat favouring the development and virulence of the organisms in the soil; hot seasons assist its activity, and particularly when hot days are followed by cold nights.

2. *Personal Proclivity.*—It was formerly considered that negroes and stable attendants were specially liable to this disease, owing to some peculiar idiosyncrasy; but such an idea cannot now be maintained. The causative organism is a facultative saprophyte—*i.e.*, is capable of continuing its development apart from the body—and is almost constantly found in garden soil, dust, or dirt of any kind. Those, therefore, who are likely to be much brought in contact with the ground, *e.g.*, negroes and agricultural labourers, owe their liability to the disease to their more constant exposure to infection. Horses are peculiarly susceptible to tetanus, and the bacilli are usually present in their fæces; hence stablemen and others brought into contact with horses are attacked with comparative frequency.

3. *Bad Hygiene* is a most important predisposing condition. Every hygienic error favours its appearance, but especially the overcrowding of sick and wounded people into a limited space, and especially if full antisepsis is impossible.

Exciting Causes.—1. The existence of a *wound*. It may follow a lesion which causes no breach of surface, such as a blow with the fist, or a bruise, but in the great majority of cases there is a definite solution of continuity of the skin. Any region of the body may be thus affected, and it is rare for tetanus to occur in any but septic wounds; where asepsis has been fully maintained the development

susceptible animals; should, however, a minute trace of toxin be present, it so depresses the vitality of the surrounding tissues that the bacilli continue to grow and produce more toxin. Hence we find that tetanus rarely occurs in man as the result of clean wounds which heal rapidly, but is much more likely to occur as the result of injuries accompanied by bruising and laceration, or in septic wounds where the vitality of the tissues is depressed by the toxins of the septic organisms; in the latter case, too, the septic bacteria absorb any oxygen present, and give rise to the necessary condition of anaërobiosis.

In pathology tetanus forms the best example of a local infection with general toxæmia. The bacilli remain localized in the neighbourhood of the wound, and do not enter the blood or reach distant parts of the body: to this rule only three or four exceptions have been recorded. In this region they produce their toxins, which act on the cells of the central nervous system in a manner very similar to strychnine. There is, however, a very unusual feature in the mode of passage of the toxin from the local lesion to the brain and cord, in that it appears to travel in the nerves themselves, and not in the blood, as in the other infections. One or two of the proofs that have been advanced in support of this theory may be quoted. Tetanus may be caused by the injection of a very small dose of toxin directly into a nerve, whereas the animal may resist the injection of four or five times this amount into a muscle; and if the nerve is cut between the site of inoculation and the central nervous system, the spasms may be delayed or even prevented altogether. This may explain the beneficial effects which sometimes followed the now abandoned operation of nerve stretching or section in tetanus. Further, the toxin can be demonstrated in the nerves themselves, since they give rise to tetanus when introduced into a susceptible animal, and it is even possible to form some idea as to the amount contained in different nerves. Thus the toxin has a special affinity for the motor nerves, and large amounts have been found in the nerve to the masseter muscle, an interesting fact in view of the frequent occurrence of trismus.

The post-mortem anatomical changes are not characteristic. The muscles are often pale, or show evidences of rupture or extravasation of blood. The peripheral nerves extending from the wound may be red and congested for some distance: this may not be due to the action of the toxin (which appears to produce no demonstrable lesions of the nerves themselves), but to septic inflammation. The nerve-centres frequently present areas of softening and perivascular cellular exudation, with some hyperæmia. Minute changes may also be demonstrated in the nerve-cells.

Clinical History.—Acute Tetanus usually manifests itself in this country two or three weeks after infection (but sometimes abroad as early as a few hours or days) by a difficulty in opening the mouth, associated with a cramp-like pain in the muscles of mastication and of the neck. This soon becomes so marked that it may

le difficult even to insert a paper-knife between the teeth (*trismus*, or lock-jaw), causing great difficulty in the administration of food; to it is added a fixed and rigid condition of the muscles of the back of the neck and of the face, the latter producing a curious grin-like appearance (*risus sardonicus*), whilst *dysphagia* is sometimes caused by spasm of the pharyngeal muscles. A considerable degree of fever is often manifested, but in some cases an apyrexial course is maintained until nearly the end. The spasms soon extend to the trunk and extremities, accompanied by cramp-like pains, and when fully established they may be excessively painful and violent, and the remissions between them but partial. Fortunately the disease usually involves the respiratory muscles late in the attack. The spasms can be excited by any form of stimulus, such as the slamming of a door, a draught of cold air, or some voluntary movement, and are always of a tonic (*i.e.*, continuous) character. The body is contorted in various directions, and respiration may be much impeded by the fixation of the thorax. Occasionally the body is arched backwards (*opisthotonos*) by the contraction of the muscles of the back, the recti abdominis being firm and tense — 'as hard as boards'; sometimes it is doubled forwards (*emprosthotonos*), and in rare cases laterally (*pleurosthotonos*). The muscles may contract so violently as to be ruptured, whilst teeth have been broken and the tongue has been almost bitten off. The intellectual faculties usually remain clear to the end, which is generally due to exhaustion from a repetition of the convulsions, or more rarely to asphyxia induced by a prolonged fixation of the respiratory muscles. Before death the temperature sometimes runs up to 108°, or even, in one case, to 112° F., and it often continues to rise for a degree or two after death; such hyperpyrexia is mainly due to the continuous muscular contractions. The surface of the body is bathed in sweat, and the urine occasionally albuminous. Death may occur in twenty-four hours from the onset of the disease, or not for four or five days.

Chronic Tetanus usually begins later after infection, is less severe in its symptoms, and more likely to be recovered from. The course is usually afebrile, and the spasmodic contractions may be limited to the wounded part of the body whence the infection has arisen, or may be general. Sometimes the patient lies in bed with his jaw partially fixed, and the muscles of his neck, back, and abdomen rigidly contracted, but with none of the characteristic convulsions.

A special variety known as *cephalo-tetanus*, or *T. paralyticus* (German, *kopf-tetanus*), follows injuries within the area of distribution of the cranial nerves, and especially those about the supra-orbital margin: it is characterized by the association of trismus with facial paralysis, although spasms, both tonic and clonic, occur in other parts of the body. Spasm of the muscles of deglutition and attacks of maniacal frenzy are sometimes present, and hence the name *T. hydrophobicus* which has been applied to it. The paralysis is supposed to be due to an ascending neuritis of the facial nerve, which becomes compressed in the aqueductus Fallopii. The

condition is uncommon, and the prognosis not quite so grave as in the acute cases.

The **Diagnosis** of tetanus is rarely difficult. In the early stages it must be distinguished from simple *trismus* arising from dental irritation, or from inflammatory ankylosis of the temporo-maxillary joint. This may be readily accomplished by noting that rigidity of the neck muscles is also present in tetanus. In the later stages *strychnine-poisoning* leads to a very similar group of symptoms, but is recognised from it by the contractions being more sudden and violent, the relaxation of the muscles between the spasms complete so that the mouth can readily be opened, whilst the hands are involved in the contractions, a rare sign in tetanus, and the muscles of mastication often escape.

No difficulty should be experienced in distinguishing tetanus from *hydrophobia*, owing to the very different nature of the convulsions in the latter case—*i.e.*, clonic and not tonic; moreover, they affect the muscles of respiration and deglutition, whilst the history of the case, the early hallucinations, and the absence of tonic muscular contractions, are also characteristic features.

Laboratory methods are usually unnecessary for the diagnosis of the disease when developed, but in case of doubt the best method is to collect some of the discharge from the deeper portions of the wound, dilute it with broth, and divide it into two parts: one of these is to be injected into a mouse or guinea-pig, whilst the other portion is mixed with 1 c.c. of tetanus antitoxin and then injected. If the former animal develops tetanic symptoms, whilst the latter escapes, the diagnosis is assured.

The **Prognosis** is unfavourable in any case, but the so-called idiopathic variety is less fatal than the traumatic. The longer the case lasts, and the lower the temperature, the more likely is the patient to recover, whilst an acute onset, hyperpyrexia, sleeplessness, delirium, and strabismus are bad signs. The length of the incubation period is also a most important factor, since it has been shown that if it is under ten days, only 4 per cent. recover; whilst if it lasts for eleven to fifteen days, 27 per cent. of cures may be expected, and if the outbreak is delayed for fifteen to twenty days, 45 per cent. of the patients live.

Treatment.—Careful antisepsis applied to wounds is the surest means of *preventing* its occurrence, and the worse the sanitary conditions in which patients are found, and the more ragged the wound, the stricter should be the measures employed; in places where tetanus is known to be rife, it would be a wise precaution to administer antitetanic serum as an immunizing agent in cases of wounds or abrasions that might possibly be infected, especially if suspicious bacilli are found on microscopic examination of a scraping from the deeper parts of the wound.

After the disease has appeared, the originating sore, if accessible, should be freely excised and the wound cauterized, or the limb may be amputated; but even then the tetanic convulsions may remain

gap between the teeth to admit of its entrance. Opium, chloral hydrate, bromide of potash, physostigma, and curare, have been vaunted as beneficial drugs, but probably cases which have recovered after their exhibition would have done so without. Chloroform should be administered to control the spasms.

Hydrophobia.

Hydrophobia is an acute general infective disease, transmitted from animals to men, especially from rabid dogs, wolves, etc. It consists in an affection of the central nervous system, and one of its most marked features is the long and variable incubation period. It never originates idiopathically either in animals or man, and although the actual virus has not yet been isolated, there can be no doubt that it is a micro-organism. Infection usually follows a bite; but if the teeth pass first through a garment, the virus may be wiped off, and the individual may escape. It has also been proved that if an infected animal merely licks an abraded surface the disease may be transmitted, even when the animal has not at the time shown any of the more typical signs of rabies.

In the **Dog**, rabies manifests itself three to five weeks after infection, but the period varies considerably; the original wound usually heals perfectly, or there may be some inflammatory thickening about it. Two chief varieties have been described—the raging or maniacal, and the quiet or dumb, *Rabies with frenzy* commences with a stage of depression, which is manifested by snappishness and irritability, especially towards other animals, by restlessness, and by the dog moping in dark corners, with a depraved appetite, eating any kind of rubbish or dirt, and even its own excreta. This period lasts for two or three days, and is perhaps the most dangerous, since there is nothing very suggestive about the symptoms. It is followed by a period of frenzy and maniacal fury, and this in turn is succeeded by a stage of paralysis, going on to death. During the whole attack the mouth is filled with ropy saliva, which the animal vainly tries to scratch away; the bark loses its ring and becomes hoarse, and as the disease progresses the lower jaw becomes paralyzed; finally, after partial or general convulsions, the animal dies five or six days from the onset. In the *melancholic or dumb form* the animal succumbs more rapidly, passing through the same stages as the above, with the exception of the maniacal period. The disease lasts then but two or three days.

In **Man** the incubation period is most variable, lasting from days to months or years, but as a rule it does not exceed six weeks. During this interval the wound heals, although the scar may remain tender and neuralgic. The disease is ushered in by a vague sense of terror, with illusions of the senses and disturbance of the mind, lasting for about twenty-four hours. Restlessness, sleeplessness, loss of appetite, and a repugnance to fluids follow, with perhaps some slight febrile disturbance. The more characteristic symptoms are inaugurated by a convulsive stiffness of the tongue, neck, and especially of the muscles of deglutition and respiration, which becomes more marked if any attempt is made to swallow. These convulsions are clonic in character, and thus differ from those of tetanus; they become more and more generalized, being brought on after a time by almost any afferent impulse, however slight—such as a blast of cold air, a flash of light, a sudden noise, especially such as is caused by the movements of fluids; swallowing is quite impracticable. The mouth is usually filled with ropy mucus, which is very difficult to remove. The respirations become catchy, and a hiccoughing noise may be produced by the spasm of the diaphragm, which is sometimes thought to resemble the barking of a dog. Finally, the convulsions may entirely cease, and the patient dies, retaining his consciousness to the end, the fatal issue being due to the destructive changes taking place in the medulla, or to exhaustion; it may, however, occur earlier, from spasm of the glottis. The disease lasts about a week, but may be more rapid, killing even in two days.

The **Post-mortem Changes** are mainly negative. Evidences of acute inflammation of the lower part of the medulla, including the centres for the 9th, 10th,

fever, it succumbs in less than twenty-four hours, and bacilli are found in nearly every organ of the body.

Some animals are immune against the attacks of anthrax, especially the dog and rat; and one of Pasteur's most useful discoveries was that of artificially providing immunity for cattle and sheep by inoculating them with an attenuated virus, obtained by exposing a cultivation for some time to a high temperature.

Symptoms.—Infection with this organism usually occurs amongst graziers who tend the living animal, or butchers who deal with the carcass; it is also met with amongst workers in hides or wool.

Malignant Pustule commences as an angry red pimple at the site of inoculation, which rapidly spreads, with much infiltration of the base, whilst the centre becomes covered with vesicles, the serum within which contains the typical bacilli. This stage is associated with no pain, but only with great itching and irritation. As the pustule extends, the central part becomes gray, and finally black, constituting an eschar or slough, whilst around it upon an area of deep brawny congestion and œdema is a narrow ring of vesicles. The process gradually becomes more marked locally, whilst the lymphatic glands and vessels are also

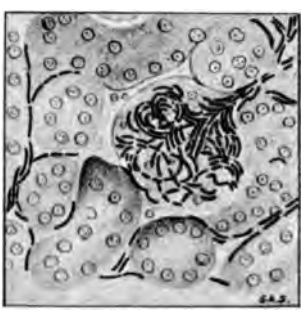


FIG. 17.—BACILLUS ANTHRACIS, FROM SPLENIC PULP OF INFECTED ANIMAL. × 1,200. (CROOKSHANK'S 'TEXTBOOK OF BACTERIOLOGY.')

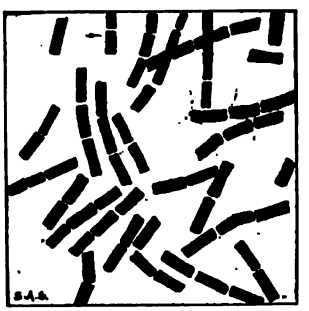


FIG. 18.—BACILLUS ANTHRACIS IN THE SUBSTANCE OF THE KIDNEY, TO SHOW HOW THE TISSUES BECOME INFILTRATED BY IT. × 600. (CROOKSHANK'S 'TEXTBOOK OF BACTERIOLOGY.')

enlarged and involved in the disease. Generally, there is a certain amount of fever and malaise, which does not become pronounced until about the fourth or fifth day. The temperature then rises to 102° or 103° F., the pulse becomes rapid and irregular, and gastric irritability, vomiting, and flatulence, more marked. Should the disease progress unchecked, the respirations become shallow and embarrassed, whilst signs of grave constitutional mischief, such as delirium or coma, manifest themselves, and the unfortunate individual rapidly succumbs, generally in less than a week from the onset, but sometimes in thirty to forty hours. More commonly the case runs a more favourable course, limiting itself to the local manifestations, which gradually clear up, the slough separating and the œdema disappearing. Of course, should there be more than one focus of mischief, the prognosis is much worse.

Anthrax œdema runs a rapidly fatal course; it is usually seen about the face and eyelids, the skin becoming red and brawny, as in erysipelas, and after a time covered with vesicles, whilst finally gangrenous patches appear. The lymphatic trunks and glands are also involved.

Woolsorters' Disease (or anthracæmia) is the term applied to the general condition resulting from the development of these bacilli in the body without any external lesion. The virus gains access to the system either by swallowing or inhaling the dried spores. If they enter the respiratory tract, the patient

of the cocci and the freedom of most of the pus-cells, whilst others are packed full of organisms, are points of great diagnostic value. Sometimes, however, most of the gonococci are extracellular.

In the male the primary lesion is in the anterior portion of the urethra, the cells of the epithelium of which are invaded by the cocci, and an acute catarrhal inflammation follows, which quickly runs on to suppuration. From this region the inflammation often spreads backward in the continuity of the mucous membrane, deeper portions of the urethra becoming affected. This tendency to local extension is very characteristic of gonorrhœa.

These local lesions usually constitute the whole of the disease, but in some cases the gonococci enter the blood-stream and affect distant organs. The joints are most frequently affected, but occasionally the gonococci attack the cardiac valves and give rise to ulcerative endocarditis (with or without pyæmic abscesses), which leads to a fatal termination. A general pyæmia or septicæmia may also arise in the course of an attack of gonorrhœa from the entrance of other pyogenic cocci (existing as a secondary infection) from the lesion in the urethral mucosa.

The Symptoms of Acute Gonorrhœa usually commence within a few days of the infection, varying from two to eight. Most commonly the discharge appears about the third or fourth day, being preceded by itching of the meatus and a scalding pain on passing urine. The lips of the meatus are congested and swollen, and the discharge, which is at first thin and mucoid, soon becomes thick, abundant, and yellow in colour. This stage lasts for a variable time, and is sometimes associated with a good deal of dragging pain in the back and loins, together with some constitutional disturbance and fever. The bowels are usually constipated, and the appetite impaired. Occasionally the swelling and congestion of the mucous membrane are so great as to lead to retention of urine or hæmorrhage from the urethra. The first attack is always more serious than subsequent ones, although it is more amenable to proper treatment. Gouty and rheumatic people are especially difficult to treat, and often suffer from relapses after the discharge has apparently ceased, and it is said that fair people suffer more than those who are dark.

If suitable treatment is adopted, the discharge entirely ceases at the end of two or three weeks; but if neglected, or sometimes in spite of treatment, the inflammation spreads backwards, giving rise to what is sometimes termed a **Posterior Urethritis**, since it involves that portion of the canal which lies behind the deep constrictor. It usually becomes evident about the end of the second week, and is characterized by frequent and painful micturition, a sense of pain and heaviness in the perineum, possibly a little blood in the urine, and a general feeling of depression. This extension backwards is always serious, since it is likely to be followed by complications involving the prostate, testis, or seminal vesicles, whilst it is an extremely common cause of **Chronic Gonorrhœa** or **Gleet**. A more or less abundant discharge continues for some time without any other

tageously employed. Both cubebs and copaiba, especially the latter, are capable of producing a bright-red erythematous rash which causes much irritation, and may be extensively diffused over the body.

The value of *injections* in the treatment of the disease has been much discussed, and is a point on which difference of opinion exists. On the whole, we are inclined to think that many of the less severe cases of acute gonorrhœa can be successfully treated without them, and that they should not generally be employed when marked local irritation or scalding is present; but when the discharge persists, or the urethra has become thickened by previous attacks, and especially in gleet, their use is imperative. To employ them with advantage, the following plan should be adopted:—The urethra is first washed out, so as to remove any discharge from it; for this purpose the normal act of micturition answers admirably, so that the injection should be used immediately after passing water. The rounded nozzle of a small glass syringe, containing about half an ounce, is inserted into the meatus, the lips of which are compressed over it. The fluid is thrown into the urethra, and held there for about twenty seconds by compressing the orifice with the finger and thumb, as the syringe is withdrawn; then, on relaxing the pressure, the fluid escapes. Other forms of syringe, on the principle of the indiarubber bottle, etc., are recommended, but the glass is unquestionably the cleanest. Of the many injections employed, one of the best consists of a mixture of tincture of catechu (10 minims to 1 ounce of water) and sulphate of zinc (2 grains to 1 ounce); but solutions of permanganate of zinc ($\frac{1}{4}$ grain to 1 ounce), or nitrate of silver ($\frac{1}{4}$ grain to 1 ounce), or protargol (1 per cent.) are also very effective. The great secret consists in using the injection four or five times a day at first, and afterwards night and morning, even after all visible signs of the discharge have ceased. The fluid should always be warmed prior to use, and care taken not to use too strong a solution.

One is bound to admit, however, that many genito-urinary surgeons hold views very different to these, and, indeed, maintain that gonorrhœa can be aborted, or, at any rate, rapidly brought under control at any stage by large injections of a weak solution of permanganate of potash, introduced with sufficient force to distend the urethra in all its parts and enter the bladder; all the crypts and lacunæ are thus reached by the antiseptic.

The **Treatment of Gleet** is always a matter of difficulty. The general habits of the patient must be attended to, as in the acute stage, whilst the bowels must be opened, and absolute sexual continence enjoined to prevent the spread of the infection. Large doses of the liq. ferri perchlor., combined with a sufficient amount of Epsom salts to prevent constipation, may be given. Local treatment is generally necessary in the shape of injections as already described, and the passage of a cold solid metal bougie every three or four days has sometimes an excellent effect. Methodical dilatation of the

urethra is also advised, with the object of compressing all the crypts and lacunæ, and removing pent-up secretion. If granular urethritis is present, the topical application of nitrate of silver may be undertaken through a urethroscope, but requires the greatest care, for fear of the subsequent formation of a stricture; chronic prostatitis and vesiculitis are dealt with by counter-irritation applied to the perineum, or possibly by sedatives, such as belladonna, administered in the form of suppositories.

Complications of Gonorrhœa.—These may be conveniently arranged under the following headings:

I. **Complications due to Direct Extension.**—*In the male*, the following may be described:

Balanitis is of frequent occurrence in patients with long foreskins. It is ordinarily due to pyogenic organisms, and not to gonococci. As a secondary result, inflammation of the lymphatics of the penis and inguinal bubo may follow.

Lacunar Abscess arises from infection of one or more of the lacunæ with the gonococcus or accompanying pyogenic organisms. A tense painful swelling forms along the floor of the urethra, which may project into the passage and discharge either into the urethra, or externally, or both; in the latter case a *penile fistula* will result. The abscess should be opened as early as possible from without, so as to prevent the latter occurrence, which is often very difficult to treat. If a fistula forms within a quarter of an inch or so of the meatus—a common situation—it seldom heals of itself, but may in some cases be closed by an application of the electric cautery or a weak solution of nitrate of silver. If, however, it remains intractable, the fistula should be laid open into the meatus. When it occurs in the body of the penis, a plastic operation is usually required; it consists in paring the edges and dissecting up the skin on either side so as to bring it together in the median line.

Chordee results from inflammatory infiltration of the corpus spongiosum or one of the corpora cavernosa, so that when the penis becomes erect, it is bent downwards or to one side, owing to incomplete distension of the infiltrated tissue. This condition is exceedingly painful, and most marked at night when the patient becomes warm in bed. It is best dealt with by applying cold to the part, and by administering bromide of potassium or opium at bedtime.

Inflammation of Cowper's Glands may in some cases give rise to deep suppuration in the perineum, with symptoms very similar to those of acute prostatitis. It is dealt with in the same way as the latter complaint.

Acute and Chronic Prostatitis (Chapter XXXIX.).

Acute and Chronic Vesiculitis (Chapter XLI.).

Epididymitis arises by extension along the vas, and will be fully described in Chapter XLI. It rarely commences before the third week, and often not until the fifth or sixth, being perhaps caused by

the injudicious use of injections, or by a blow or squeeze, especially if the scrotum is lax and pendulous.

Acute Cystitis (Chapter XXXIX.).

In the female, the primary lesion is usually either in the urethra or in the cervical endometrium, or in both. In the former case the inflammation may spread to the bladder and cause cystitis, whilst in the latter extension may take place to the endometrium of the body of the uterus, the Fallopian tubes (salpingitis), ovaries, and peritoneum. In the latter case the inflammation is usually localized, producing adhesions round the fimbriated extremities of the tubes, which are an important cause of sterility; a general peritonitis may result, but this is unusual.

Gonorrhœal vaginitis is uncommon in the adult, and hardly exists as a primary lesion; it often happens that the pus and discharge from the cervix accumulate in the vagina and undergo septic decomposition. In this case the vagina may be inflamed by the direct action of the bacterial products, but its mucous membrane is not attacked by the gonococci. In children a true gonorrhœal vulvo-vaginitis occurs.

II. **Complications arising from Direct Transmission of the Virus.—Gonorrhœal Proctitis** sometimes results in the female from infection by the discharge which escapes from the vulva, whilst in both sexes it may be due to unnatural practices. It is characterized by tenesmus and a thick muco-purulent discharge, and is treated by injecting lotions of acetate of lead and opium, or of boric acid.

Gonorrhœal Rhinitis has also been seen in a few cases. It leads to an abundant discharge of pus, and should be treated by warm, soothing injections, followed after a time by dilute astringents.

Gonorrhœal Conjunctivitis occurs either in adults, when it is unilateral to start with, or in infants, when it is bilateral, and due to infection during transit through the maternal passages (*ophthalmia neonatorum*). It is a remarkable fact that, although gonorrhœa is so very prevalent, such a small proportion of the patients suffer from conjunctival infection; it would appear, therefore, that not only must there be direct contact with the gonorrhœal poison, but in addition the mucous membrane must be in a receptive state. In the adult variety it is ushered in by redness and irritability of the eye, followed quickly by a discharge which is at first mucous, but soon becomes purulent. The eyelids are red and swollen, the conjunctiva is thickened and œdematous (chemosis), and the discharge liable to accumulate within the conjunctival sac. If allowed to progress unchecked, the cornea may be injured by the inflammatory process, ulceration or even necrosis ensuing, and possibly general panophthalmitis. The first detail in the **Treatment** consists in protecting the opposite eye by means of what is known as Buller's shield; a watch-glass is fixed in a piece of mackintosh over the eye, and kept in position by plaster. The affected conjunctiva must be unremittingly attended to night and day, so as to prevent accumulation of discharge; it is frequently irrigated with warm boric acid

lotion, and every four hours the membrane is carefully washed, dried, and swabbed over with a solution of nitrate of silver (5 grains to 1 ounce). Between the applications lint wrung out of iced boric acid lotion is kept over the eye. This plan of treatment is continued until the suppuration ceases, and then the silver salt is omitted, and simple astringents, such as chloride or sulphate of zinc, substituted.

In *infants* the disease often runs a rapid and severe course, and is very likely to lead to ulceration or sloughing of the cornea, a complication not uncommonly followed by escape of the lens and blindness. Crede's preventive treatment should always be adopted for new-born children, viz., washing out the conjunctival sac with a weak solution of nitrate of silver or corrosive sublimate soon after birth. When suppuration occurs, the treatment to be adopted is practically identical with that detailed above, except that it is useless to attempt to limit the trouble to one eye.

III. **Complications resulting from General Absorption.** **Gonorrhœal Affections of Joints** are not uncommon sequelæ, arising usually in the subacute stage of the disease. They occur either in the form of a synovitis with effusion, or as an arthritis, which may or may not suppurate, but generally ends in ankylosis. When suppuration takes place, only gonococci may be found in the pus, or they may be associated with other pyogenic organisms, and then the prognosis is decidedly worse: occasionally pyogenic cocci are alone present. Not unfrequently the pus or serum from a gonorrhœal joint is found on examination to be free from germs, even on cultivation, the gonococci having died after causing the inflammation. Such an occurrence is always suggestive, as sterile pus from an *acute* abscess is unlikely to be due to ordinary pyogenic bacteria. For clinical features and treatment, see Chapter XXII.

Any muscular, tendinous, ligamentous, or aponeurotic tissues may become inflamed and painful during the course of an attack of gonorrhœa. Special mention must be made of the involvement of the ligaments supporting the arch of the foot, since, if the cause is not recognised and the patient is still allowed to walk, the arch of the foot may be lost, and a permanent flat foot result.

Gonorrhœal Sclerotitis, or inflammation of the deep subconjunctival fibrous tissue, is a rare affection, arising quite independently of gonorrhœal conjunctivitis. It is characterized by marked subconjunctival redness, the globe of the eye becoming distinctly tender. Local applications of atropine are required, and, if need be, leeches to the temples.

The pathology of the complications described in the last two paragraphs is uncertain. They are probably due to the presence in the tissues of a small number of gonococci of enfeebled virulence, but it is also possible that they are caused by toxins absorbed from the local lesion.

Soft Chancre.

A **Soft Chancre** is a local infective disorder, which is rarely seen elsewhere than on the genital organs, and is almost invariably the result of impure connection. It is due to a specific bacillus, which was first described by Ducrey. It is an extremely slender rod, which does not form spores or stain by Gram's method. It frequently occurs in short chains. The organism has been cultivated, though with difficulty, and there appears to be no doubt as to its causal relation to the disease. If artificially inoculated, it runs a typical course. The spot becomes a distinctly red papule in twenty-four hours, whilst in two or three days a vesicle, surrounded by a zone of angry hyperæmia, is seen. The serum within the vesicle soon becomes turbid, and by the fourth or fifth day a fully-developed pustule is present; as soon as the cuticle is lost, an ulcer forms with cleanly-cut edges, and a sharp, distinct outline. The chancre gradually increases in size up to a certain limit, and then if kept clean heals in about three weeks. Such sores may be met with on any part of the penis, but more especially on the prepuce and glans, or on the corona glandis, and are very painful and tender. The secretion is highly infective, and if inoculated elsewhere on the patient produces a typical sore, showing that the condition is purely local, and that no constitutional immunity results from its presence. The discharge from a true syphilitic chancre, if inoculated on the same patient, may produce a localized pustule, but no typical sore. Frequently several sores are present at the same time, whilst the discharge from one chancre is very likely to produce a similar affection ('satellite' chancre) on any cutaneous or mucous surface brought into contact with it; *e.g.*, it may spread from prepuce to glans, or *vice versâ*, or from one lip of the vulva to the other. It is a curious but well-authenticated fact that soft chancres are rarely seen on any part of the body other than the genital organs.

Various **Modifications** of the typical chancre are seen, usually resulting from neglect or carelessness on the part of the patient. Thus, if a long foreskin is present, the discharge may be retained behind it, and an extensive ulcerating balanitis occur, which may even result in the glans sloughing through the upper part of the prepuce, which drops beneath it. If the frænum is involved, smart hæmorrhage takes place from ulceration into a branch of the artery found in that structure. When there is much inflammation, the base of the sore becomes indurated and infiltrated, somewhat resembling the Hunterian chancre. Not unfrequently syphilitic infection occurs at the same time as a soft chancre is contracted, or subsequently; the sore is then likely to run a longer course, does not heal, even if kept clean, and after a time the patient presents the characteristic signs of syphilis.

In all cases the neighbouring **Lymphatic Glands** become enlarged and tender, and the process is very liable to terminate in suppuration, constituting a bubo. Two forms of this affection are described:

(*a*) The *simple* or sympathetic bubo results from the absorption of ordinary pyogenic organisms from the abraded surface. The pus in this case, if inoculated elsewhere, may produce a pustule, but not a true chancre. The process is usually limited to the interior of the lymphatic glands. (*b*) The *virulent* bubo is one due to the absorption into the lymph stream, not only of pyogenic organisms, but also of the specific virus, so that when suppuration ensues, the pus, if inoculated, always produces a typical soft sore. In these cases the suppuration occurs not only within, but even more abundantly around the lymphatic glands (*periadenitis*), so that the skin becomes considerably undermined, and the wound produced by opening the abscess may take on the form of a huge soft chancre in the groin, in the centre of which may be seen the lymphatic gland only slightly enlarged.

The **Treatment** of soft chancre consists in keeping it clean, dusting its surface with iodoform, and covering it with lint dipped in lotio nigra or boric acid lotion, healing usually occurring in from ten to twenty days; where much balanitis exists it may be necessary to slit up the prepuce, but circumcision should not be undertaken until the sores have healed. The surface of the chancre may be treated with caustics, such as pure carbolic or nitric acid, and may perhaps heal quicker for such applications; but they need not be employed as a routine treatment, since soft chancres, if kept clean, are usually devoid of serious consequences. If the smell of iodoform is objected to, iodol or aristol may be substituted.

Buboes are treated in the early stages by keeping the patient at rest and applying fomentations, when resolution sometimes occurs. If suppuration ensues, the abscess should be incised vertically, so as to allow free exit to the pus, even when the patient is sitting, the cavity being subsequently dressed by stuffing it with gauze impregnated with iodoform. Some surgeons recommend that enlarged glands of this nature should be freely removed by dissection, but such is not required as a general rule.

We now come to a group of diseases which have been classified by Virchow under the term **Infective Granulomata**. They are all characterized by the formation of growths more or less resembling granulation tissue, which either persist or undergo various degenerative changes. They are all infective in nature, and most of them chronic in their progress, although acute manifestations are occasionally met with. Five conditions are included under this heading, viz.: Syphilis, Tuberculosis, Glanders, Leprosy, and Actinomycosis.

Syphilis.

Syphilis is an infective disease resulting from inoculation with some specific virus, the nature of which has not yet been identified with certainty. Lüstgarten demonstrated an organism in the initial lesion which was supposed to be the bacillus of syphilis, but it was

probably nothing more than that frequently present in smegma. The recent researches of Metchnikoff, Neisser, and others, who have found that the anthropoid apes, unlike all other animals, are susceptible to the disease, offer hopes that the infective agent may be discovered in the near future. These observers have already shown that the specific organism is not (as was formerly thought probable) of ultra-microscopic size, since it is unable to pass through a Berkefeld filter. It has also been shown that the virus is not present in the clear serum from the blood of syphilitic patients, and that this fluid was devoid of immunizing properties, since apes that had been treated with large quantities could be subsequently inoculated with the disease.

Syphilis is characterized by the appearance of a primary sore, usually known as a hard chancre, which is followed in the course of a few weeks by evidences of general infection, referred mainly to the skin and mucous membranes, comprising the secondary stage. After a variable time, known as the intermediate period, during which symptoms may be absent, tertiary manifestations may show themselves in any and every part of the body.

Mode of Infection.—Acquired syphilis is almost always due to infection of the genital organs arising from impure connection. Occasionally cases are met with in which the disease is transmitted by other means (*syphilis insontium*), and then the primary lesion is often located on some other part of the body (extragenital chancres); thus, the lip may be infected as a result of drinking out of the same glass or smoking the same pipe as a syphilitic patient, or even by kissing. The disease is not always equally infectious; in the primary stage the discharge derived from the chancre will alone convey the contagion; in the secondary period the virus is found in the blood of the individual, and hence all pathological exudations, as also the blood itself, may transmit the disease. Pure secretions, *e.g.*, milk or urine, are free from infection, although if mixed with a serous exudation from abraded surfaces, as so frequently occurs in the case of the saliva, they at once become infective. The semen is probably an exception to the above rule, since, although the maternal passages may entirely escape, the ovum becomes diseased. It is usually held that in the tertiary stage the patient is no longer capable of transmitting the affection.

The syphilitic virus is exceedingly resistant to the action of antiseptics, and hence the risk of infection is very great, even though prompt measures are taken to destroy it. Thus, many cases are on record in which an abraded surface was brought into contact with a syphilitic poison, and, although cauterized with fuming nitric acid within a few hours, the disease ran its ordinary course. In one case, however, under our observation, in which a student's finger was accidentally pricked with a bent broad needle, which a moment before had been inserted into the anterior chamber of a syphilitic patient suffering from a secondary suppurative iritis, nitric acid was applied within a quarter of an hour, and although a suspicious

indurated spot formed six weeks later at the site of injury, no other evidences of syphilis have been observed, in spite of the fact that the individual had not previously suffered from the disease, and took no mercury.

One attack of syphilis usually confers immunity on the patient from further outbreaks of the disease, even if exposed to infection. This protection is not always permanent, since well-authenticated cases have been observed of second attacks of syphilis, in which the primary lesion was on each occasion followed by distinct signs of general infection.

Course of the Case.—The stage of **Incubation** lasts for a variable period, extending from two to six weeks; as a rule evidences of induration of the sore can be detected about the third week. It is probable that long ere this the virus has entered the circulation, and hence removal or destruction of the local lesion has not the slightest influence upon the progress of the case, unless it can be undertaken immediately after infection. During this period the local sore may heal completely, if it is purely syphilitic, and nothing further is noticed until the typical induration manifests itself. Not unfrequently, however, pyogenic infection occurs or a soft chancre is also present; in the latter case the lesion does not heal satisfactorily, and the base of the ulcer becomes indurated after a time.

I. **The Primary Stage** of syphilis is characterized by the development of a typical primary sore, associated with enlargement of the neighbouring lymphatic glands. It is usually situated on the base of the prepuce, close to the corona glandis, or on the frænum; in the female the inner aspects of the labia majora or nymphæ are the most common sites.

The primary sore does not invariably present the same appearance, although it is always characterized by a certain amount of infiltration and induration. Should the superficial abrasion have healed, a localized growth of almost cartilaginous hardness forms in the cicatrix, closely adherent to and invading the cutis; but if a soft sore has first developed, the surface remains ulcerated more or less deeply, though the base becomes indurated. The following are the chief forms in which the chancre manifests itself. (*a*) The *desquamating papule* is a slightly elevated spot, which is extremely irritable, of a dusky colour, and free from ulceration. It is usually small, but hard, and its surface covered with epithelial scales. If exposed to friction or to the irritation of retained discharges, ulceration is very likely to take place, and an ordinary Hunterian chancre will then form. Unless this occurs, it may run its course unobserved, and thus a patient becomes syphilitic without being able to trace the time or source of infection. (*b*) The indurated, hard, or *Hunterian chancre* is that most commonly seen; it results from the irritation of a papule, or is developed in association with a soft sore. It consists of a distinctly localized infiltration and induration of the submucous or subcutaneous tissues, giving rise to a lump which feels like a pellet of cartilage; or the induration may be more extensively

diffused through the surrounding structures. In some cases there may be but little elevation of the growth, and the surface is free from ulceration, constituting the variety known as the 'parchment induration' of Ricord, and not unfrequently seen on the glans penis. Where, however, the prepuce or body of the penis is involved, greater induration takes place, owing to the laxity of the connective tissue. When affecting the base of the prepuce, the induration usually spreads transversely, producing a collar-like mass, which on retraction of the part rolls back *en bloc* in a very characteristic manner. Examined microscopically, the new formation consists merely of a mass of round and spindle cells packed closely together, with a certain amount of intercellular fibrous tissue; giant cells are sometimes seen. The blood-supply of the part is scanty, a fact which explains the readiness with which ulceration occurs. Several chancres may be seen on the same individual if the infection occurs at one time, and it is possible that a patient could be infected at two different periods if only a short interval elapsed between the inoculations; but the disease is not generally auto-inoculable, and when once a hard chancre has developed on the under surface of the prepuce, the glans does not become infected from contact. Multiple chancres are always of small size, and the induration is less marked than usual.

A **Urethral Chancre** is usually situated just within the lips of the meatus, constituting a sore with an indurated base. It may be felt as a hard nodule on grasping the urethra between the fingers, and gives rise to a thin serous discharge, often blood-stained. The orifice itself is sometimes the site of a chancre, and the induration may completely encircle it. This condition is very apt to be followed by a stricture.

Extragenital Chancres are most commonly observed on the lips, finger, and nipple. They are usually characterized by a greater amount of infiltration and less distinct and definite induration than in the forms met with on the genital organs; hence the swelling is more prominent and vascular, and if ulceration occurs there is a greater amount of discharge, which forms a thick scab over the surface. The neighbouring lymphatic glands are enlarged, and sometimes surrounded by infiltrated tissue. This condition has often been mistaken for epithelioma, from which, however, it can be distinguished by the character of the sore, its rapid development, and the earlier enlargement of the glands. The course of the case is generally more severe than when the primary lesion is in the usual situation, a fact possibly explained by the disease remaining unrecognised till secondary symptoms appear.

Digital chancres are usually seen in surgeons and accoucheurs, and start by the side of the nail. An indolent sore appears, which becomes infiltrated and ulcerates, spreading under the matrix and along the semilunar fold. There is a good deal of discharge and pain, and the terminal phalanx becomes swollen and bulbous. The epicondyloid and axillary glands are enlarged as the case progresses,

and the condition has more than once been mistaken for malignant disease.

Phagedena is a form of spreading ulceration, rarely met with at the present time except in connection with venereal disease and seldom apart from syphilis. It always attacks unhealthy and debilitated individuals, especially men with phimosis. The discharge, often abundant and sometimes offensive, is retained under the long foreskin, which together with the end of the organ becomes red, swollen, and infiltrated. On dividing or retracting the foreskin, the affected surface is found to be sloughy, and the ulceration, unless checked by treatment, rapidly spreads, and may destroy glans and prepuce, and even attack the body of the penis. A similar condition is occasionally seen in connection with an inguinal bubo, and then the integrity of the femoral vessels is threatened.

The **Treatment** consists in division of the foreskin if that structure has not been already destroyed, followed by prolonged immersion of the patient in a hot bath. If the patient cannot be kept for twelve or twenty-four hours in a warm bath, it will suffice to immerse him in warm water for two or three hours every day. In the intervals the wound should be dusted with iodoform, and dressed with lint dipped in lotio nigra. Under such circumstances, the surface of the sore quickly cleans, and becomes covered with healthy granulations. The after treatment is conducted as for primary syphilis, although the depressed condition of the general health may necessitate the administration of tonics and even a visit to the seaside. Should treatment by immersion in hot water be for any reason impracticable, the old-fashioned plan must be resorted to, viz., scraping the sore, and freely cauterizing the base with pure carbolic or fuming nitric acid. Possibly, where there is much slough, this may advantageously precede immersion in a bath.

The **Lymphatic Glands** which receive lymph from the region in which the sore is situated become characteristically enlarged. They move freely under the skin and feel hard, like bullets, pellets of cartilage, or almonds (hence the term 'amygdaloid' which has often been applied to them); they are usually quite painless, and there is no tendency for them to suppurate if the infection is purely syphilitic; but if the original sore is septic, or also inoculated with the virus of a soft chancre, an abscess often follows, one or more of the inguinal glands breaking down, and causing a painful, red, and brawny infiltration of the superjacent integument. After a time the skin gives way, and is often found extensively undermined.

Occasionally the lymphatic vessels extending from the sore to the glands become the seat of a chronic lymphangitis, and may be felt as hard cords beneath the skin. The dorsal lymphatic of the penis is frequently blocked in this way, and gives rise to solid or lymphatic oedema of the prepuce and glans. Should the chancre suppurate, an abscess may form in the course of the lymphatics.

The **Diagnosis** of a syphilitic from a soft sore is not always easy. Of course, where there is no ulceration, and the typical induration of the base can be felt, no doubt need arise. But when the primary sore is septic, and an excavated ulcer is present, surrounded by infiltrated and hyperæmic tissues, it is difficult to be certain as to the nature of the case. The inguinal glands are enlarged in both varieties, and the fact that suppuration occurs proves nothing. Even the existence of a 'satellite' chancre from auto-inoculation only demonstrates the presence of a soft chancre; it does not prove the

absence of syphilis. In such cases it is often necessary to wait for the development of secondary symptoms before a decided opinion can be given. For Justus's test for syphilis and its value, see p. 45.

The **Duration** of the primary sore varies in different cases, and depends in great measure on whether treatment is commenced early or late. If the case comes under observation during the first six weeks, and a mercurial course is at once started, the chancre heals, and the induration usually disappears in from six to eight weeks. The glands in the groin, however, remain enlarged for some time. The longer the case is left untreated, the more slowly does the hardness disappear. If no mercury is given, the induration may last for twelve months or more, and then slowly passes off, although it may run a much shorter course. From an uncomplicated syphilitic sore but little scar results, although a well-marked cicatrix may follow a soft or septic chancre.

Re-induration of the cicatrix sometimes occurs from too early a cessation of the mercurial course, or from some localized irritation, or from a fresh exposure to infection. It is occasionally due to a tertiary or gummatous development, and will then be free from lymphatic complications.

II. **Secondary Syphilis.**—In the secondary stage, the virus is diffused generally throughout the body by means of the blood, which is itself infective. A certain amount of constitutional disturbance may exist, the patient feeling 'seedy' and out of sorts, whilst in some cases distinct febrile phenomena and headache have been noted. Well-marked anæmia is often present, and on examination the red corpuscles are found to be deficient in number, and defective in the amount of hæmoglobin contained within them. The chief secondary manifestations consist in the appearance of various forms of rash on the skin and mucous membranes, associated with a general enlargement of the lymphatic glands, sore throat, mucous tubercles and condylomata, loss of hair, and other less common phenomena, and these usually show themselves in from seven to nine weeks from the time of inoculation, although they may be delayed to a much later date. Their intensity also varies considerably, the phenomena being sometimes scarcely evident, and at others very marked. They are also influenced greatly by the period at which the administration of mercury commences; the earlier the drug is given, the less obvious are the secondary phenomena.

The **Cutaneous Eruptions** of secondary syphilis are chiefly characterized by the fact that, although any form of rash may be simulated, no specially distinctive variety is originated. Moreover in the same individual the eruption is not always of the same character throughout, several distinct types developing in different parts of the body (*polymorphism*). The rash is usually more or less symmetrical, the colour in the early stages being a dusky red resembling that of raw ham, whilst later on it becomes of a more coppery hue; occasionally, however, it may be a bright rosy red. Syphilitic rashes do not completely fade on pressure, but leave

brown stain, and give rise to but little irritation or itching; they always tend to progress from the simpler types, due to hyperæmia, to the more serious, in which infiltration and overgrowth are evident.

In the simplest form, merely a hyperæmia is present, sometimes appearing as a dusky mottling of the skin (*roseolous* syphilide), which quickly fades or may persist whilst other types are developing. If distinct papillæ become infiltrated and hyperæmic, a *papular* syphilide is said to be present; such may become either vesicular or pustular, constituting the *vesicular* or *pustular* syphilides; the latter change is uncommon, and only appears in bad cases or in debilitated patients. Another form of eruption is the *squamous* syphilide, characterized by patches of hyperæmia and infiltration, combined with superficial desquamation. It is usually bilateral, and, unlike simple psoriasis, affects the flexor rather than the extensor surfaces. In the later stages, distinct nodules or tubercles are produced in the skin, which may even run on to ulceration (*tubercular* syphilide).

As to the *situation* of the rash, the roseola is usually limited to the abdomen, whilst the other forms are often widely scattered over the trunk and extremities, involving, however, the flexor more than the extensor surfaces of the limbs. A somewhat characteristic phenomenon is the appearance of a papular rash on the forehead, sometimes known as the *corona Veneris*.

The **Mucous Membranes** may be affected in much the same way as the skin. The fauces become red and congested, the hyperæmic area being abruptly limited, and semicircular in outline; symmetrical ulceration usually follows, starting near the anterior pillars of the fauces, and spreading to the tonsils and along the soft palate to the uvula. These ulcers are shallow, have sharply-cut edges, and often present a characteristic grayish appearance, constituting what is known as a 'snail-track' ulcer. The secondary sore throat rarely results in extensive loss of substance, and hence pharyngeal stenosis is not common at this period of the disease. Smoking undoubtedly aggravates these conditions. Concurrently with these manifestations in the fauces bare patches from loss of epithelium may be seen on the dorsum of the tongue, or several small superficial, but very painful, ulcers may develop on the inside of the cheeks or lips.

Mucous tubercles and condylomata are somewhat similar affections, though more pronounced, arising in the secondary stage in connection with mucous membranes and those parts of the skin which are soft and moist. **Mucous Tubercles** consist of slightly-raised patches of enlarged and infiltrated papillæ, white in appearance from the superficial epithelium becoming sodden, and often progressing to actual ulceration. Examined microscopically, the papillæ are found to be definitely enlarged, and the epithelium heaped up over them. They are most commonly observed at the corners of the mouth, on the inner aspect of the cheeks, the side of

the tongue (often due there to the irritation of rough teeth), or the margin of the anus; in the last-named situation they are usually symmetrical, one side being infected from the other. They are also not at all uncommon between the toes, and the ulcers caused thereby become exceedingly offensive from septic contamination. **Condylomata** are similarly the result of overgrowth of the papillæ, differing from mucous tubercles merely in the extent to which this has been carried. They consist of definite wart-like masses, which may attain a great size, constituting a cauliflower-like growth. They are most commonly seen about the anus or vulva, in the former situation being often mistaken by the patient for piles; they give rise to an abundant, highly infective discharge. A similar condition is sometimes met with on the dorsum of the tongue, and is then known as 'Hutchinson's wart.'

The **Lymphatic Glands** are usually enlarged throughout the body during this period of the disease, being felt as round, hard swellings beneath the skin. The extent of the glandular complication is possibly a measure of the degree of virulence of the affection. The condition of the nuchal and epicondyloid glands should always be ascertained in suspicious cases, since, if no obvious local cause exists for their enlargement, syphilis is very probably present.

Syphilitic Alopecia.—The hair becomes dull and lustreless, and either comes out in patches from the scalp, eyebrows, beard, etc., or there is a general 'thinning.' The follicles, however, are not destroyed, and after a time the hair will grow again as before.

Later secondary manifestations consist of flying pains in the bones (osteocopic), iritis, and various nervous lesions, whilst periosteal nodes may form on the tibiæ and other bones, or a symmetrical chronic effusion develop within the synovial membrane of joints.

Syphilitic Iritis is characterized by pain in the eye, generally referred to the supra-orbital nerve, together with some interference with vision, and possibly a little lachrymation and photophobia. On examination a bright-red circular zone immediately surrounds the cornea, resulting from hyperæmia of the ciliary vessels. The iris is lustreless, and its definition somewhat blurred. Its colour is changed, a blue iris becoming greenish-yellow from the presence of lymph. The pupil is diminished in size, and perhaps irregular; its movements are always considerably hampered, and sometimes entirely prevented, by the formation of adhesions either to the back of the cornea (anterior synechiæ) or to the lens capsule (posterior synechiæ). Occasionally small yellowish nodules are seen on its surface, consisting of plastic lymph.

The **Duration** of the secondary stage varies considerably, and is largely influenced by the character of the treatment and the period at which it is commenced. The sooner the patient is brought judiciously under the influence of mercury, the less severe the secondary phenomena, whilst cases in which treatment has been delayed are likely to be more troublesome. Hence the disease is

often of an aggravated type when following extragenital chancres, as also in women, by whom the primary lesion often passes unnoticed. When treatment is commenced within four or five weeks of infection, the secondary stage may be slight, and all traces of its existence may pass off in two months or less; if mercury is not administered until the cutaneous eruption has appeared, this stage is likely to last longer. The condition of the patient's health is an important factor, as also the previous habits, particularly as to temperance, since syphilis always follows a more aggravated course in the weakly and the dissipated. Even under the best circumstances, the patient is liable to outbreaks of the affection within the first twelve months. *Relapses* are by no means uncommon, being

FIG. 13.—RUPIA OF FACE. (FROM WAX MODEL IN MUSEUM OF ROYAL COLLEGE OF SURGEONS.)

usually due to intermissions in the treatment. The rash which appears under these circumstances is often of a more characteristic type, the papules being grouped into rounded or corymbose figures.

III. The **Intermediate or late Secondary Stage** comprises a group of symptoms which form a link between those already described and the tertiary phenomena; and, indeed, no distinct limits to this period can be defined, nor need it appear at all if the patient's general health is good, and the treatment has been carried out regularly. Some of the secondary manifestations, especially those of the bones and joints, may persist through this period, whilst even if they have disappeared, the patient is liable to suffer from 'reminders' in the shape of various cutaneous affections and

perhaps epididymitis. Deep lesions of the eye (choroido retinitis) and of the central nervous system (syphilitic monoplegia) are not uncommon, the latter usually arising from anæmia of the cerebral centres due to a syphilitic endarteritis. The principal cutaneous affection is the so-called **syphilitic psoriasis**, most frequently seen on the palms and soles. A squamous syphilide is often observed in the secondary stage, but is then symmetrical and readily influenced by mercury. In this intermediate period, the lesion may be bilateral or limited to one side, according to whether it appears early or late. In the former there is a considerable tendency to proliferation of the epithelium, together with deep cracks and fissures; in the latter there is less epithelial overgrowth, but the edges are often distinctly serpiginous in outline, and there is an infiltrated border.

Rupia and **Ecthyma** are both met with in this stage of the disease. They are characterized by an infiltration of the skin, which progresses to ulceration. In rupia the discharge forms a distinct scab on the surface, which increases in thickness by the deposit of successive layers one under the other, each being somewhat larger than the one which precedes it; hence a scab shaped like a limpet-shell is produced, resting on an inflamed and hyperæmic base (Fig. 19); any part of the body may be affected in this way. In ecthyma no scab forms over the ulcerated surface, or, if formed, it readily comes away, leaving exposed a hollow punched-out sore, surrounded by an area of vivid congestion. Under appropriate treatment these conditions disappear, but leave depressed, whitish cicatrices, often surrounded by pigmentation.

A somewhat unusual intermediate manifestation is a subacute symmetrical epididymitis, in which the cord also becomes thickened, enlarged, and tender.

IV. **Tertiary Syphilis.**—The phenomena occurring in this stage may appear within six months of infection, or not for twenty or thirty years. They are mainly characterized by infiltration and overgrowth of the connective tissues of the body. Such may occur in one or many places, and may be diffuse or localized. In the former case the organ or part affected becomes enlarged, hard, and sclerosed, and unless the condition is treated promptly, the normal tissue of the part may entirely disappear, being replaced by fibro-cicatricial tissue. If, however, the process is localized, a **Gumma** is formed.

Any tissue in the body may be the seat of a gummatous deposit, which apparently arises without any definite cause, although occasionally its onset may be determined by an injury. The involved area becomes occupied by a cellular infiltration, the component cells of which are partly large oval epithelioid cells, and partly small round cells (lymphocytes); plasma-cells are usually present in considerable numbers. The constituents of this mass are quite similar to those which are found in a tubercle, but without the grouping into small nodules and the more or less orderly arrangement in zones;

giant cells are usually absent, though their presence is by no means rare, and they may closely simulate the tuberculous type. This structure gradually increases in size, infiltrating and replacing the normal tissues of the part. Very few vessels penetrate into the mass thus formed, which otherwise resembles granulation tissue. The fate of the fully-formed gumma varies according to circumstances. If the infection is a mild one, and especially if appropriate treatment is adopted, a certain amount of organization into fibrous tissue may take place, and the bulk of the cells may become absorbed, so that even a large gumma may almost entirely disappear, a small fibrous scar being the only indication of its occurrence.

In the absence of proper treatment most gummata undergo a necrotic change. This may be a comparatively slow process, so that fatty degeneration has time to occur, in which case it closely

FIG. 21.—CUTANEOUS GUMMATA ON OUTER SIDE OF THIGH.

resembles the caseation seen in tubercle, or it may be a more rapid form of coagulation-necrosis, in which the tissues undergo a kind of mucoid degeneration, forming a gummy mass from which the lesion acquires its name. In either case the necrotic process commences in the centre of the nodule and extends until it involves the whole of the mass except the growing edge which is spreading into the normal tissues of the part. Sections through such a gumma will show a large white structureless mass of necrotic or caseous material, surrounded by a shell of cellular tissue, which gradually merges into the normal structure of the part. Two factors are concerned in the production of this necrosis: the toxins produced by the causative bacteria and the deficient blood-supply of the central portions of the cellular mass. The vessels of the gumma are deficient from the first, and after a time the amount of blood which reaches them is diminished as the result of a syphilitic endarteritis of the arterioles in the neighbourhood. Moreover, some gummata do not commence

to undergo central necrosis until a certain amount of transformation into cicatricial tissue has taken place, in which case a still further interference with the blood-supply may be caused by the compression of the vessels traversing the newly-formed fibrous tissue.

Under appropriate treatment the whole of the gummatous mass may be absorbed, even where caseation or necrosis has taken place; but not unfrequently the gummy, semi-purulent fluid which is formed at the centre of the mass finds its way to the surface and is discharged. Where the necrotic mass is large, a portion of it may remain adherent to the surrounding tissues after ulceration has taken place, looking somewhat like a piece of wet wash-leather. Under exceptional circumstances the central slough may become encysted by the formation of a fibrous capsule, and calcification of the centre may even occur; this is stated to be most frequently found in the brain, testis, and liver.

Clinically, the appearances vary according to whether the gumma is cutaneous or subcutaneous.

Cutaneous gummata (Fig. 20) are very frequently observed in tertiary syphilis, especially in the earlier stages. They occur as dusky-red nodules of firm consistency, and but slightly painful. Many such growths are often grouped together in one region, and when ulceration has occurred, they produce by their confluence sores with a rounded or serpiginous outline. Considerable destruction of tissue follows, but they are readily cured, giving rise to depressed white cicatrices, surrounded by pigmentation. Any part of the body may be involved, but a very common site is about or just below the knee, on the outer, rather than the inner, aspect of the leg.

Occasionally a diffuse infiltration of the skin is met with in this stage, appearing as a red hyperæmic area with a rounded or serpiginous border, and not at all unlike lupus in appearance. It is readily amenable to treatment, and runs a much more rapid course than lupus; the edge is usually thickened to the same extent all round, and there is but little tendency to the formation of outlying nodules. The apple-jelly-like granulations so typical of lupus are of course not present. A cicatrix is usually produced, even if ulceration has not taken place.

A *subcutaneous gumma* develops as a firm nodule or an indefinite thickening, which gradually increases in size by the infiltration of surrounding tissues, and sooner or later approaches the surface; the centre of the tumour in time becomes elastic and fluctuating; a certain amount of pain and tenderness is noticed, and when the skin is affected, it becomes dusky and even œdematous. If ulceration follows, the contents of the gumma escape, and the sore produced is deep, the edges being sharply cut and perhaps undermined; the base of the ulcer consists of granulation tissue, although it is sometimes covered by the characteristic slough.

The peculiar features of tertiary syphilis, as it affects special regions, will be described under the appropriate headings: *vid*

syphilitic diseases of arteries, of lymphatic glands, of muscles, of bones, of joints, of the lips, of the pharynx, of the tongue, of the larynx, of the rectum, of the testis. The symptoms arising from gumma of the brain will be alluded to in Chapter XXVI., but the general relation of syphilis to the nervous system has been purposely omitted, since it belongs rather to the physician than to the surgeon.

The **Prognosis** of syphilis is good if the patient comes under treatment at a sufficiently early stage, and if he has no idiosyncrasy which prevents the administration of mercury or iodide of potassium. In persons suffering from extragenital chancres, which are not recognised till late, the disease often runs a more than usually severe course. The general health of the patient, and perhaps a peculiar predisposition, may influence the evolution of the case, whilst the co-existence of tuberculous disease may render the prognosis peculiarly unfavourable, especially when the disease is inherited. The character of the rash, and the extent of the general glandular enlargement in the secondary stage, may perhaps give some indication of the gravity of the case; where the eruption is but slightly marked, the other symptoms are usually mild, whilst a pustular eruption is almost always of grave import. Death is rarely produced by any of the secondary manifestations, but may occur in the tertiary stage, when important viscera, such as the brain, spinal cord, liver, etc., are involved.

As to the **Curability** of syphilis, the general opinion held at present is that, if the disease is seen early, and treated satisfactorily, the patient will in all probability never suffer from any further manifestations after the secondary symptoms have disappeared. A cure can, however, never be definitely promised, since, should the general health of the patient become impaired, characteristic syphilitic phenomena may make themselves evident even thirty or forty years after the primary lesion. There is also no doubt that certain cases are to be looked on as absolutely incurable, owing probably to the fact that they were not brought under treatment until tertiary phenomena were present; such are usually seen amongst females.

The **Treatment** of syphilis consists in the administration of mercury during the primary and secondary stages, and of iodide of potassium, with or without mercury, in the late secondary and tertiary periods.

Many different methods have been suggested for the *administration of mercury*, in order that the patient may derive the greatest amount of benefit from the drug with the minimum of inconvenience. (*a*) It is usually given *by the mouth*, either in the form of pills composed of gray powder (grs. i.—iii., t.d.s.), or of the green iodide (gr. ½ i., t.d.s.), or as a mixture containing a solution of corrosive sublimate. The last method is distinctly objectionable, inasmuch as its prolonged use in sufficient doses disturbs the digestion. Gray powder is perhaps the best means of giving the drug; the patient should commence with 2 grains, given three times a day, or in some cases 1½ grains

four times a day, combined with a little extract of opium or pulv. ipecac. co. if there is any tendency to diarrhœa; but this addition is not always needed. This should be cautiously continued until all prominent signs of the disease have disappeared, and then the dose is gradually reduced. (*b*) *Inunction* of the mercurial ointment is also frequently adopted, and with great success, inasmuch as it is less likely to cause digestive derangements. If the ordinary officinal ointment is employed, a portion as large as a hazel-nut is rubbed into the groin or axilla nightly, the part being washed the following morning, and not used again for this purpose for three or four days; if the ointment is made up with lanoline, a somewhat smaller amount is required. Possibly this is one of the best ways of bringing a patient rapidly under the influence of the drug. (*c*) *Mercurial vapour baths* may be advantageously employed where the cutaneous eruption is very extensive. The patient sits naked on a cane-seated chair, and covered with a blanket or specially constructed cloak reaching from the neck to the ground, and not touching the body; 20 or 30 grains of calomel are placed on a metal plate surrounded by a trough containing about 1 ounce of water. The water is boiled, and the calomel sublimed, by means of a spirit-lamp placed under the chair. In about twenty minutes all the calomel will be volatilized, and deposited in part upon the skin of the patient, who perspires freely during the process. He then gets into bed between warm blankets, without wiping the skin. This treatment may be combined with medication by the mouth. (*d*) Mercury is sometimes administered by subcutaneous injections, in the form of the perchloride, $\frac{1}{2}$ grain or less being injected once or twice a week into the substance of the gluteus maximus. A little thickening of the site of injection results, but quickly passes away, and suppuration scarcely ever follows. The succinamide is another useful salt for this purpose; a 2 per cent. solution is employed, and the usual dose is from $\frac{1}{6}$ to $\frac{1}{4}$ grain injected into a muscle every two or three days; it is well borne and causes no irritation.

During the course of mercury, the patient's general health and habits must be carefully regulated, all excesses in drink and diet being forbidden, and strict instructions given as to keeping the teeth and gums clean. To minimize the risk of throat and mouth trouble, it is wise to stop all smoking for at least six months. The dose required varies in different individuals, being increased in robust people, and diminished in those who are weak or unhealthy. It should always be pushed until mild physiological effects are produced in the shape of slight tenderness of the gums, but salivation of the patient is undesirable. Full doses are usually required for four or five months, followed by a milder course, which should extend till the end of the first year.

Symptoms of excessive *mercurialism* are generally induced by overdoses of the drug, but in some people a very small dose suffices to produce severe effects; hence treatment should always commence with small doses. When mercury is producing toxic effects, the

gums become soft and spongy, and bleed readily on pressure. Salivation follows, and even acute glossitis may be produced, whilst the breath becomes offensive. In worse cases the teeth are loosened, and necrosis of the alveoli has followed. Derangements of the digestion, in the shape of colicky pain and diarrhœa, are also observed. The treatment of this condition consists in suspending the administration of the drug for a time, and giving a sharp saline purge, whilst the spongy state of the gums is remedied by the use of an alum or chlorate of potash mouth-wash.

Iodide of potassium is essential in the treatment of the tertiary and intermediate stages. It appears probable that its chief action is the removal of gummatous tissue, and that it has little influence upon the causative disease; in order to prevent recurrence, mercury is still required. The dose of iodide should not exceed 5 grains to start with, and is gradually increased until in some cases 1 drachm four times a day has been reached. A feeling of depression and sinking at the epigastrium is often produced, but may be alleviated by the addition to the mixture of sal volatile (℥. xv.) or carbonate of ammonia, as suggested by the late Sir James Paget. Symptoms of coryza may follow, and an acneiform eruption over the shoulders and face, which, however, often disappears on increasing the dose. Sometimes a vesicular, or even bullous, rash is caused by this drug. When large doses are given, bicarbonate of soda or potash must be combined with it, in order to prevent its decomposition by the gastric juice, and plenty of water should always be taken immediately afterwards to assist in its dilution and facilitate its absorption. The iodides of sodium and ammonium are sometimes substituted for the potassium salt, on the plea that they give rise to less depression.

Other drugs, such as sarsaparilla and iron, are often combined with iodide of potassium in the later stages of the disease, and may be useful.

The **Local Treatment** of syphilitic sores consists mainly in the application of various preparations of mercury. The *primary chancre* is usually treated with lotio nigra on lint, iodoform being sometimes employed if septic ulceration is present. *Mucous tubercles* in the neighbourhood of the anus or vulva, or between the toes, are best dealt with by keeping them scrupulously dry and clean and dusting them over with powdered calomel, or by the application of calomel ointment, a piece of lint being inserted between opposing surfaces to keep them from rubbing one against the other. Secondary ulceration of the *throat* does not usually require local treatment, as it soon disappears under the influence of mercury. A mercurial gargle may, however, be employed, or in bad cases calomel may be placed on a hot copper coin, and its vapour inhaled. *Superficial gummatous ulcers* are treated by removing the scabs, and applying some form of mercurial ointment. A determined attempt should be made to keep deep gummatous ulcers in an aseptic condition, since the advent of sepsis to such sores, especially if they are connected with bones, makes a marked difference in their progress. In neglected cases the

wound may become exceedingly foul, and in chronic cases a hectic temperature and amyloid degeneration of the viscera have been observed. When gummata come to the surface and point, they should be opened with the same precautions as are adopted in the case of an abscess, and either dressed antiseptically or their cavity packed with sterilized lint or gauze soaked in sterilized lotio nigra.

Inherited or Congenital Syphilis.

Syphilis may be conveyed to the ovum either by direct transmission from the father or mother alone, or both parents may be tainted with the disease. Occasionally the mother acquires syphilis during pregnancy, and in such cases the fœtus also becomes affected. In those instances where the ovum is infected from the father, whilst the mother has escaped, the latter becomes in measure protected, so that, if the child is put to her breast, she does not contract the disease, even though there are ulcerating lesions on the child's gums and lips; healthy wet-nurses are invariably infected (*Colles's Law*). Whether the immunity is permanent or not is still a matter of uncertainty, and even the inviolability of this law has recently been called in question. The immunity of the mother has been attributed to the production of antibodies in the fœtus and their passage into the maternal blood, but the recent researches of Neisser on the higher apes seem to disprove the existence of such substances; it is more probable that the mother owes her immunity to a mild and unrecognised infection with the disease itself. *Profeta's law* is the reverse of Colles's, and asserts that the child of a syphilitic mother or father is immune to syphilis, although it has never presented evidences of infection with the disease.

The length of time during which a patient retains the power of transmitting the disease to the fœtus is an exceedingly difficult point to determine, and one which is constantly coming before the practitioner, who is asked to decide at what period it is safe for a syphilitic patient to marry. The rule of practice generally followed is that no one suffering from syphilis should be allowed to marry until he or she has been free from all symptoms for at least twelve months, and even then it is advisable that a mild course of mercury should be given for about three months shortly before marriage.

A syphilitic fœtus often fails to arrive at maturity, the mother miscarrying at the end of six or seven months. This is probably due to a specific affection of the endometrium, especially involving that portion of the decidua which enters into the formation of the placenta. The circulation and nutrition of the fœtus are thereby impaired, so that it is usually born not only dead, but in many cases macerated and partially decomposed. This may be repeated for several pregnancies, and then a living child is produced. In many cases, however, a living child is born at full time at the end of the first pregnancy, in spite of the syphilitic infection of the parents.

At birth the child often appears healthy and well nourished, but is sometimes small and imperfectly developed. The first definite symptoms of the disease manifest themselves at a variable period, extending from three weeks to three months, after birth; the child becomes thin and emaciated; the skin, which hangs in wrinkles over the body, changes to a dull earthy colour, whilst the features looked pinched and wizened, like those of an old man. Marked anæmia is always present, and may persist for a considerable time. Speaking generally, the symptoms of inherited syphilis are similar to those of the acquired disease, except that the primary lesion is absent. Thus, during the first year of life the child develops various cutaneous eruptions, mucous tubercles, and superficial ulceration of the mucous membranes. A dusky red roseola, especially about

Fig. 21.—Child with Inherited Syphilis, showing Radiating Scars round the Mouth. (From a Photograph kindly lent by Dr. G. F. Still.)

the nates (napkin area), may first be noticed, but does not last long. This is usually followed by the appearance of mucous tubercles at the angles of the mouth, in the nose, and around the anus, as also in the moist folds of the groin, and between the scrotum and thigh. The sores on the lips are sometimes very marked, giving rise to ulcerated surfaces, which, by their subsequent cicatrization, leave radiating scars (or rhagades), especially about the angles of the mouth (Fig. 21). Other cutaneous affections, such as squamous syphilides of the soles of the feet, together with papular syphilides of the body, and a bullous eruption becoming pustular (pemphigus), are also observed, the last mentioned, however, only occurring in debilitated infants. A catarrhal rhinitis is a very early and constant manifestation, giving rise to obstructed nasal respiration, or *snuffles*.

This affection is often protracted, going on to ulceration destruction of the nasal bones and cartilages; their subse development is thus prevented or impaired, and hence the bri the nose remains depressed and sunken, even when adult l reached (Fig. 22). Enlargement of the spleen and liver is common.

Many infants during the first year of life die from malnutriti marasmus; but if properly treated a considerable proportion r their health within six or eight months, all the manifest described above disappearing, although their scars may re

FIG. 22.—HEAD AND FACE OF A PATIENT WITH INHERITED SYPHILIS, SH DEPRESSED BRIDGE OF NOSE AND FRONTAL BOSSES. (FROM A PHOTOGR

The child's subsequent development is frequently impaired it often retains an almost pathognomonic facies.

After the first year, any of the tertiary phenomena which a in acquired syphilis may develop, but, in addition to these, pe manifestations may be produced, especially affecting the teeth, l and cornea.

The **Teeth** in inherited syphilis are sometimes very characte The temporary teeth usually appear early, are discoloured crumble away. The permanent teeth are often sound and he but are sometimes deformed. The central incisors of the upp are those most particularly affected, but the upper laterals an incisors of the lower jaw may also be involved. Instead of broader at the crown than at the root, they diminish in size

tuberculous disease. It is better, however, to avoid the use of such misleading terms.

Ætiology.—1. The *individual* is often predisposed to the development of this disease by some inherited weakness, as indicated by the fact that parents, relations, or ancestors have suffered from some similar affection, or that it has occurred in other branches of the same family. It is becoming doubtful, however, whether heredity plays such an important part as was formerly attributed to it, and whether the disease is not much more commonly due to direct infection. Considerable ingenuity has been exercised in describing various types of physiognomy supposed to be characteristic of a tuberculous inheritance, and although not always present, these appearances are not unfrequently observed. Two chief varieties are described, viz., the *sanguine* and the *phlegmatic*. In the former, the individual is slight and well proportioned, possessing a thin, delicate

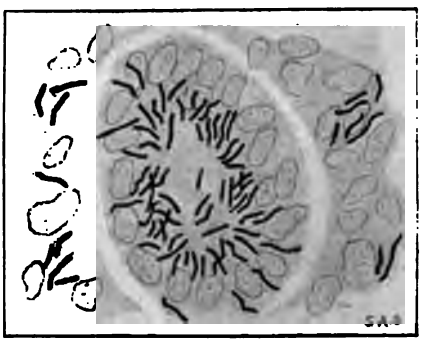


FIG. 23.—BAC. TUBERCULOSIS IN AND AROUND GIANT CELL. (CROOKSHANK'S 'TEXTBOOK OF BACTERIOLOGY.')

skin, often freckled, and so transparent that the subcutaneous veins are readily seen. The hair is fine and auburn-coloured, or even reddish, the conjunctivæ are thin and pearly, the eyelashes well developed, and the fingers long and tapering. Such children are usually excitable and precocious in their habits, and possess taking manners. The phlegmatic type is characterized by a short, stunted stature, with somewhat coarse features, and strong though somewhat short limbs. The skin is coarse and muddy-looking, the lips thick, the hair rough and brown. In children of either type there is a considerable tendency to the development of eczema, inflammation of the mucous membranes, and a subacute enlargement of the lymphatic glands, all of which are simple in nature, but may constitute a suitable nidus for the development of tubercle, especially if the child is run down by some preceding illness, such as measles or scarlet fever. They also suffer frequently from cracked lips, and as a result of the irritation caused thereby considerable infiltration and thickening may follow. Although tuberculous disease is most

The organism gains access to the body in one or other of the following ways:

(*a*) Most commonly by *inhalation*. Tubercle bacilli are present in vast numbers in the sputum of consumptives, and, as drying does not immediately kill them, they frequently occur in the dust and in the air. More important still is the fact that in coughing and talking the tuberculous material is expelled in a state of very fine division, and the infective particles remain suspended in the air for long periods. Tuberculosis acquired by inhalation usually manifests itself in the form of pulmonary disease, but may appear as a primary affection of the bronchial glands, from which the infection may be disseminated to other organs. The bacilli may also lodge on or in the crypts of the tonsils, and cause tuberculosis of the glands in the neck, but this probably occurs more often when the infection is carried by the food.

(*b*) By *ingestion*. This is comparatively rare, and usually manifests itself in primary tuberculosis of the intestines or abdominal lymph glands. It should be remembered that these lesions may also be caused by swallowing tuberculous sputum.

(*c*) By *inoculation*. This is very unusual, and occurs chiefly in pathologists, post-mortem room porters, etc., in the form of a verruca necrogenica (p. 243). A few cases of tuberculous infection from an accidental cut inflicted by a broken sputum cup have been recorded.

(*d*) A few cases of *congenital* tuberculosis may possibly be caused by the presence of tubercle bacilli in the ovum or spermatozoon, but this is almost incapable of proof.

The *pathological diagnosis* of tuberculosis is conducted on one or other of the following lines:

1. By the microscopic identification of the tubercle bacillus, *e.g.* in the sputum. Films are stained by the Ziehl-Nielsen method, and searched for the characteristic rods. This is sufficient when bacilli are present in large numbers, but when this is not the case (as frequently happens in the urine, pus, pleuritic fluids, etc.) it is necessary to have recourse to—

2. Inoculation of susceptible animals, especially guinea-pigs, which is a most delicate test. The material is usually inserted beneath the skin of the groin, and the animal killed in three weeks, when the lymph glands and probably the internal organs will be found tuberculous.

3. Tuberculous exudates differ from most others in that the cell which occurs most abundantly is the *lymphocyte*, and this fact is made use of in the examination of pleuritic and peritoneal exudates, the fluid obtained by lumbar puncture of the spinal meninges, etc. It is useful, but must not be regarded as an absolute test.

4. In some cases a portion of the lesion may be excised and submitted to microscopic examination, which should include a search for bacilli, since other infections may give rise to lesions indistinguishable microscopically from tuberculosis. It is still better to inoculate a portion of the tissue into a guinea-pig.

The *development* of a tubercle is not yet fully understood. The bacilli appear to gain access to a lymph space or to a small vessel, where they set up an overgrowth of the endothelial elements, and, as always happens when they become inflamed, the endothelial cells become oval or spherical, and of large size; these constitute the epithelioid cells of the middle zone. The giant cells* appear to be composed of a mass of these cells, in which the nuclei have undergone repeated divisions, but the protoplasm has remained unsegmented. The source of the lymphocytes, and whether they are produced locally or attracted from the blood-stream, has been hotly debated. It appears on the whole most probable that they are formed locally, possibly by a process of budding from the endothelial cells.

Miliary tubercles may be embedded in practically normal tissues, but in most cases the inflammatory process can be traced beyond the nodules. The affection of the surrounding parts varies. In mild cases there is a chronic inflammatory process, with an increased formation of fibrous tissue, whilst in the more active forms the intervening structures disappear, being infiltrated and replaced by granulation tissue, which is often œdematous and of a gelatinous appearance. This latter is especially frequent in tuberculosis of the bones and joints. The effect of the inflammation of the surrounding parts is especially marked in the smaller vessels, and chiefly in the arterioles, the lumina of which may become greatly narrowed, or even entirely obliterated, by a process of endarteritis. In this condition the vessel wall becomes infiltrated with leucocytes, which collect in the subendothelial layer. They become mixed with fibroblasts, the origin of which is uncertain; and the cellular mass gradually undergoes organization, layers of fibrous tissue, concentric with the original coats of the artery, being produced. The vessels may also be affected by the production of true tubercles in their walls, but this is much rarer. In either case the vascular affection diminishes the blood-supply of the tuberculous mass (which is already defective owing to the fact that no new vessels are formed in the tubercles), and increases the likelihood of caseation.

A fully-formed tubercle may undergo *evolution* along one of the following lines, according to the virulence of the bacilli and the resisting powers of the patient.

1. When the bacilli are but slightly virulent and the patient's susceptibility moderate, the tubercle undergoes *fibrosis*: this is the natural method of cure. In a fibrosing tubercle the endothelioid

* It may be well to notice here that three forms of giant cells occur pathologically, and are of very different significance: (1) Those described above (the tuberculous type), having their nuclei arranged around the periphery of the cell; (2) Myeloplaxes, which occur in myeloid sarcomata, and have many nuclei grouped irregularly round the centre of the cell; (3) Parenchymatous giant cells occurring in the substance of tumours, especially sarcomata and carcinomata. These have usually a single nucleus, or at most a few, which may be of large size and have no definite arrangement.

parted to the pus; microscopically, they appear as flat rhomboidal plates with one corner notched out.

Abscesses may also form in a tuberculous nodule as a result of secondary infection with pyogenic bacteria. This is an entirely different process, and one that is usually much more serious for the patient. The pus in this case may not differ appreciably from the ordinary pus of acute abscesses, and the fact that it contains tubercle bacilli may only be demonstrable by inoculation.

The *microscopic appearance* of a tuberculous *abscess wall* is quite characteristic (Fig. 25). The cavity is lined by a layer of gray, yellowish-gray, or pinkish, pulpy granulation tissue, containing miliary tubercles, perhaps undergoing caseation. Its colour and vitality are dependent upon the chronicity or not of the process; the longer the abscess is in forming, the less vascular the membrane, owing to the associated sclerosis of the surrounding structures leading to compression of the bloodvessels, whilst it has been already mentioned that endarteritis always accompanies a chronic inflammation, and helps to render the parts non-vascular. This lining membrane, when necrotic, is but loosely connected with a layer of fibro-cicatricial material, which forms the outer part of the wall, and from which it can be readily detached by the finger or a sharp spoon. This, in turn, gradually shelves off into the normal tissue which surrounds the abscess.

A chronic abscess forms a soft fluctuating swelling which gradually increases in size, and may become painful by exerting pressure on a nerve or other sensitive structure. Should it be *superficial*, it will probably come to the surface and burst; the pus and caseous detritus will be discharged, and possibly, if the general health is good, the wound may slowly granulate and heal; but more commonly the tuberculous tissue left behind prevents healing, and a *tuberculous ulcer* develops. A similar condition is found in connection with mucous membranes, the tuberculous foci starting in the submucosa, and subsequently bursting through the mucous membrane (Fig. 26). Whatever their location, the ulcers are characterized by the same features, viz., an irregular and ragged margin with undermined and congested edges; the base is formed by pulpy granulation tissue containing caseous masses of tubercle (i_1), which usually must be removed by scraping before healing can occur.

On the other hand, if the abscess is of *deep* origin, it has a great tendency to burrow along fascial planes, and hence to become superficial at a distance from its original source. This is especially the case in tuberculous disease of the spine, in which the pus may travel far afield, *e.g.*, in a psoas abscess. The far-reaching extent of these abscesses, the impossibility of dealing adequately with the lining membrane, together with the infective nature of the disease and the often inaccessible position of the original focus of the mischief, render them most difficult to treat, and fully account for the dread of opening them experienced by surgeons in pre-antiseptic days; for should the cavity of the abscess once become septic, there is but little hope

probably through dissemination by the bloodvessels. Thus phthisis is a not uncommon sequence of a similar affection of bones, joints, or lymphatic glands, whilst meningeal tuberculosis is more frequently associated with tuberculous affections of the genital organs. (*c*) Moreover, any tuberculous lesion may lead to *acute general tuberculosis*, in which the disease is scattered widely throughout the body, giving rise to rapid emaciation, high fever of an intermittent type, and usually severe diarrhœa, dyspnœa, and delirium or coma, death ensuing in a few weeks.

Treatment.—It must be fully recognised that tuberculosis is an infectious, and therefore, to a large extent, a preventable disease, and it is the duty of all medical practitioners to do everything in their power to limit its ravages. We cannot here enter into this subject, but would merely mention the dangers to the general public arising from the distribution of milk obtained from tuberculous cows, and from the indiscriminate expectoration of tuberculous sputum.

Curative treatment is based on the assumption that natural processes of repair have a considerable influence upon the course of the disease. When Koch first discovered the bacillus, a great impetus was given to surgical treatment, and some authorities went so far as to maintain that it was as necessary to extirpate every particle of diseased tissue as in a case of cancer. The pendulum has now slowly swung back, and we are more and more endeavouring to promote healthy repair of the lesions by constitutional measures. The value of an abundance of fresh air is fully admitted, and many sanatoria for the open-air treatment of phthisis and other tuberculous lesions are now in existence. For surgical cases residence by the seaside, especially in such bracing places as Margate, or, if that be too cold, Ramsgate, Bournemouth, or Ventnor, is usually recommended. At the same time, plenty of good food, such as milk and eggs, must be taken. Local foci should be kept at rest, and if the disease is external, elevation and steady pressure (as by Scott's dressing) are desirable accessories. On the other hand, if a tuberculous lesion is sufficiently localized and suitably situated, as when it occurs in the lymphatic glands of the neck, total excision is the ideal treatment, although one has sometimes to be satisfied with scraping. In this process the possibility of disseminating the disease by too vigorous manipulations must not be overlooked. Any open tuberculous sores should be well scraped, overhanging and undermined portions of skin cut away, and the surface then swabbed over with liquefied carbolic acid, and dressed with gauze soaked in an iodoform emulsion.

The manifestations of tubercle as it affects **special organs** are dealt with elsewhere under the appropriate headings (see diseases of skin, bones, joints, lymphatic glands, kidney, testis, etc.).

Treatment of Chronic Tuberculous Abscess.—The conditions under which chronic abscess presents and upon which it is dependent are so diverse that the treatment must necessarily vary considerably in

different cases. A superficial chronic abscess is comparatively easy to treat, but one placed deeply, and connected with such an affection as tuberculous disease of the spine, must be approached with caution; and seeing that one slip in the technique might lead to a fatal issue, no one should undertake to deal with these cases unless they are fully competent to maintain asepsis. That it is desirable to evacuate the abscess cavity in the vast majority of cases is obvious, although under specially favourable circumstances one might leave the condition to be dealt with by Nature; this, however, would involve the risk of an acute disturbance, due to a possible pyogenic infection, whilst it would also entail subsequent dangers owing to the encapsulation of tuberculous material within the body. Hence the ideal treatment always consists of removal of all tuberculous tissue and evacuation of abscesses. The following plans may be adopted:

1. In certain cases of external chronic abscess, especially when connected with lymphatic glands, it may be possible *to dissect out the whole cavity en masse*, and if such is feasible, it is the most satisfactory plan to adopt. Should the posterior wall of the cavity be adherent to important deep structures, it should be thoroughly scraped so as to remove all pyogenic material, and disinfected, *e.g.*, with liquefied carbolic acid or solution of zinc chloride (40 grains to 1 ounce). An attempt may then be made to gain healing by first intention, or the cavity may be stuffed and allowed to granulate.

2. When the skin is thin and undermined, and the abscess nearly pointing, it is hopeless to avoid leaving an open wound; and hence the condition must be treated on the same way as many a case of superficial abscess which cannot be dissected out—viz., by the *open method*. The cavity is laid freely open, all tuberculous tissue is scraped away, unhealthy skin is excised, and the cavity, if not too large or deep, is treated with pure carbolic acid or chloride of zinc (gr. xl. ad ℥ i.), packed with gauze infiltrated with iodoform, and allowed to heal from the bottom. In deep collections of this type—*e.g.*, a psoas abscess—a tube may be introduced for a time, and subsequently the cavity packed as far as possible. Every care must be taken to avoid retention of discharge and to prevent sepsis. At the same time the patient must be placed in the best hygienic conditions possible, and in this way it may be possible to bring about a cure; but we would urge on practitioners the fact that a psoas abscess ought never to be allowed to reach a condition in which it is necessary to leave an open wound on account of the abscess pointing.

3. When a chronic abscess is situated deeply and covered with healthy tissues, treatment consists in emptying the cavity of its contents, removing as far as possible the tuberculous lining membrane, and closing up the wound after introducing into the cavity some modifying or antiseptic injection.

In many cases tapping with trocar and cannula suffices for this purpose. The *modus operandi* is as follows: The skin over the abscess is incised, and a large trocar and cannula introduced so as to allow the contents to escape. The cavity is then washed out with sterilized salt solution (℥ i. ad O i.) at a temperature of 105° to 110° F., and the abscess wall well kneaded from the outside so as to detach curdy material and necrotic pyogenic membrane. This is continued until the escaping fluid is nearly clear or only slightly opalescent. A varying quantity of an emulsion of iodoform in glycerine (10 per cent.) is then introduced, and the opening closed by a stitch or two. In this way it is often possible to cure a chronic abscess at one sitting. The treatment is most likely to be efficacious when all active bone or joint disease has disappeared, and residual abscesses are perhaps the most favourable of all.

Where the disease is more active, it is often wiser to make an incision into the abscess sufficiently large to introduce the finger. Through this opening diseased bone can possibly be removed and the lining wall scraped, and for

this purpose a Barker's flushing gouge is often useful. The instrument consists of a gouge or sharp spoon with a long hollow handle, which communicates by a tube with a reservoir of fluid placed at some height above the patient. During its application the constant rush of water or lotion through the handle clears the gouge and removes the débris. It is admirably adapted for certain cases, but its use needs considerable care, as the sharp edge can readily scrape through an abscess wall, and do much mischief. The wounds should be subsequently closed after injecting the iodoform emulsion, and an attempt made to gain immediate healing of the denuded cavity by bringing the sides into apposition by suitable pressure.

Not uncommonly the cavity refills with fluid in the course of three or four weeks, and the irrigation may then have to be repeated. The fluid withdrawn on this occasion is often blood-stained serum, perhaps smelling strongly of iodoform. It is possible that in such cases a sinus develops sooner or later, and has to be dealt with by simple drainage, or, when the discharge is but slight, by packing. The convalescence under these circumstances is always very prolonged ; and if sepsis is to be avoided, great care will have to be exercised in dressing the case.

The employment of iodoform in these cases is largely due to Professor Velpeau. It may be suspended in glycerine or olive-oil (10 per cent.) or dissolved in ether (5 per cent.) ; but as a rule not more than a drachm of iodoform should be injected. When the ethereal solution is employed, the ether immediately volatilizes and fully distends the abscess cavity, which becomes tense and tympanitic ; it must therefore never be used for abscesses communicating with the interior of the thorax, death having in one or two recorded cases resulted from heart failure, due to such distension. There is some danger, too, that serious toxic symptoms may arise from absorption of the iodoform.

Glanders.

Glanders is primarily a disease of the horse, ass, or mule, which is transmitted to men by direct inoculation, and hence is usually seen only in stable attendants and those brought in contact with such animals. It is characterized by the development of inflammatory swellings under the mucous membrane of the respiratory tract, which break down and ulcerate, and by the formation of similar growths, embolic in origin, in the lungs and other viscera, which go on to abscess formation.

There is now no doubt that the disease is due to a definite micro-organism, the *Bacillus malléi*, which was isolated about 1882 by Schutz and Löffler, and has since been cultivated outside the body ; the experimental evidence as to its being the cause of the malady is quite complete.

In **Horses** and other animals, glanders manifests itself by a formation of larger or smaller rounded swellings in the mucous membrane of the nose, which break down and ulcerate, giving rise to a thin, sero-purulent discharge, and perhaps to destruction of the bones and cartilages. The lymphatic glands, especially those under the jaw, early become enlarged, constituting the 'farcy buds' of farriers, and by their ulceration may leave ragged, foul sores. The lymphatic trunks to and from the glands are involved ('corded veins'), whilst the lungs and internal viscera may also be infected, and undergo destructive changes, usually ending in suppuration. The disease is often chronic, lasting perhaps for years ; any undue strain put upon the animal may lead to an acute outbreak, which is fatal in six to twelve days.

In **Man**, glanders generally starts about the hands and face, but occasionally in the nasal mucous membrane. In *acute* cases the incubation period lasts from three to five days, and is succeeded by the occurrence of malaise and febrile disturbance, followed by severe pains in the bones and joints. The site of inoculation becomes swollen and angry, whilst the lymphatics leading from this to the nearest glands are enlarged and inflamed. An eruption of papules, which somewhat resemble those of small-pox, occurs around the primary lesion, on the

face, and in other parts of the body; but each papule, as also the primary lesion, breaks down and goes on to the formation of an ecthymatous-looking ulcer. It is not an uncommon feature of these sores, when placed over a bony surface, to involve the periosteum and lay bare the subjacent bone. Similar changes occur in the viscera, muscles, and joints, and these being associated with high fever of an asthenic type, may suggest the existence of pyæmia. In such cases death may ensue in seven to ten days.

In **Chronic Glanders** similar symptoms are met with, but the course is slower; there is little or no fever; the disease is less extensive, and intermissions are not uncommon. Total recovery is stated to occur in 50 per cent. of the cases. It may affect the nasal mucosa, leading to chronic ulceration, but more commonly it appears in the shape of chronic abscesses, which often extend deeply, even down to the bones, and are very difficult to deal with. In one case the disease gradually spread down along the peronei muscles, and in spite of repeated scrapings and the application of pure carbolic acid, the process was only arrested at the point where the peroneus longus disappears into the foot.

It is important to determine the **Diagnosis** as early as possible, in order to undertake energetic local treatment. The local lesions are distinguished from *small-pox* by the presence of the characteristic bacilli in the discharge, by the fact that they more extensively involve the subcutaneous tissues, and by the absence of umbilication. Chronic cases resemble *syphilis* and *tuberculosis*, but the history of exposure to infection from animals suffering from the disease is most important, as also the result of cultivations made from the discharge. When the bacilli are grown on potatoes, a colony of a yellowish, honey-like character forms in two or three days, which gradually turns to a chocolate-brown colour. Inoculation of the peritoneal cavity of a guinea-pig with some of the secretion leads to acute orchitis in two or three days, the testicles being enlarged and the skin over them reddened; the affection usually runs on to suppuration. Malkin, a sterilized culture of the organisms, may also be used for diagnostic purposes, an injection of a minute dose causing a sharp febrile reaction if glanders is present.

Treatment in acute cases can be of use only when undertaken early, and before general infection has ensued. The local foci should be thoroughly extirpated, either by the knife, or by scraping and applying some active cauterizing agent. The same treatment must be adopted in chronic cases, and may then need frequent repetition.

Leprosy.

Leprosy (syn.: *lepra*, or *elephantiasis Græcorum*) is a general infective disease due to the *Bacillus lepræ*, characterized by the formation of granulation-like neoplasms, which arise primarily in connection with the skin and nerves.

The bacillus of leprosy closely resembles that of tuberculosis, and, like it, is strongly acid-fast, staining by Ziehl-Nielsen's method. The two organisms are difficult to distinguish, but the leprosy bacilli are usually straighter and more uniform than those of tubercle; and when seen in sections of leprous material they are often present in far larger numbers than are the tubercle bacilli in tuberculous tissues. They are usually packed together like bundles of cigarettes (Fig. 27). Numerous attempts have been made to cultivate them, and a few observers claim to have succeeded, but their results have not been generally

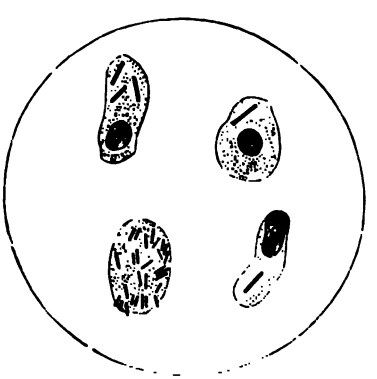


FIG. 27.—LEPROSY BACILLI CONTAINED WITHIN EPITHELIAL CELLS.

accepted. All attempts to inoculate animals with the disease have failed, and inoculation constitutes the best and most definite test between the two diseases.

Leprosy, though formerly common in this country, is now only met with in imported cases. In Iceland, Norway, Russia, and the East, it is still frequently met with, although the method of segregation of lepers enforced in Norway has greatly diminished the number in that country. It is apparently very slightly contagious. The medical attendants and nurses in leper hospitals rarely contract

FIG. 28.—LEPROSY. (FROM A PHOTOGRAPH KINDLY LENT BY W. THELWALL THOMAS, ESQ., OF LIVERPOOL.)

The patient had lived as a sailor, and contracted leprosy abroad many years before. The facial aspect is very characteristic, and the forearms are enlarged owing to leprous deposits in the subcutaneous nerves.

the disease, and inoculation experiments in criminals have led to negative results. Mr. Jonathan Hutchinson has argued that infection only takes place in persons who eat badly-cured or partially decomposing fish. Opinions differ as to whether the disease is transmitted to the descendants, but probably this is not the case.

Symptoms.—Two chief varieties of leprosy exist, viz., the tuberculated and the anæsthetic, or non-tuberculated; but the two are often associated.

Tuberculated or **Cutaneous Leprosy** is the form most commonly seen in Europe. Nothing may be noticed for months or years after exposure to the contagion, and then, after a period of malaise, associated with dyspepsia, diarrhœa, and

(the wooden tongue, big jaw, or 'osteo-sarcoma' of cattle). These often suppurate in many places, producing multiple chronic abscesses, which discharge externally and leave a diffuse inflammatory mass riddled with sinuses. The pus from such

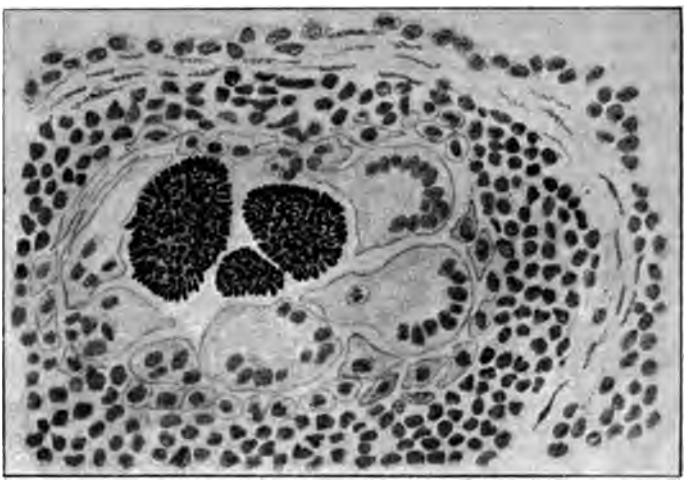


FIG. 29.—BOVINE ACTINOMYCES IN TONGUE. (FROM CROOKSHANK'S 'TEXTBOOK OF BACTERIOLOGY.')

abscesses contains small yellow or brown gritty bodies (often looking like grains of iodoform) which consist of colonies of the fungi, perhaps undergoing calcareous changes. The structure of these colonies may be made out by crushing the particles between two slides and staining the films thus produced, but is better seen by an examination of sections. Each colony consists of a tangled mass of mycelium, the central portion of which often shows the presence of 'chain spores,' whilst the peripheral part has a definite radial arrangement, from which the organism derives its name. The mycelial filaments which project from the outer portion of the colony are often greatly thickened, and appear in the form of Indian clubs, the narrow ends being pointed inwards. These 'clubs' were formerly thought to be reproductive organs, but are probably caused by a degeneration of the sheaths of the filaments. They are very well seen in bovine actinomycosis (Fig. 29), but are often absent or very badly formed in man.

FIG. 30.—COLONY OF HUMAN ACTINOMYCES, AS SEEN IN PUS.

The absence of the radially-arranged 'clubs' is very obvious.

In **Man** the disease is very similar in its clinical character, and may be caused by a number of organisms belonging to the streptothrix group. Strictly speaking, it is not a specific disease like tuberculosis, but a group like the suppurative diseases. The organisms form colonies

The commonest site for the primary lesion is close to the angle of the jaw, where it constitutes a cervico-facial tumour of tolerably characteristic appearance. At first the mass has a smooth, regular, and even surface, and merges gradually into the surrounding tissues; the skin over it is usually hyperæmic. As time passes, little nodular excrescences, with a peculiar yellowish apex, form here and there on the surface of the tumour, and these finally soften, point, and burst, giving exit to a small amount of glutinous pus, in which the actinomycotic nodules can be demonstrated. When all the fungus has been discharged, the abscess contracts and the wound closes. The cicatrization induced by the constant repetition of this process makes the surface of the mass curiously nodular and puckered (Fig. 31), and this condition, when present, is almost pathognomonic. Trismus is an almost constant symptom in the cervico-facial form of the disease, coming on early, and being apparently independent of the size of the mass or its involvement of nerves.

The **Treatment** most recently advised consists in the administration of large doses of iodide of potassium (grs. 20 or 30 three times a day), which seems to have almost as great an influence in this disease as in syphilis. This alone may suffice when there is no open wound; but if open sores are present, surgical measures must also be employed. Extirpation of all the infiltrated tissue, either by the knife or by vigorous scraping, should be undertaken, and the part freely cauterized; in fact, it must be treated in exactly the same way as a diffuse tuberculous mass. This can, however, only be very partially carried out in the visceral affections.

CHAPTER VIII.

TUMOURS AND CYSTS.

Although the term 'tumour' is often used for any abnormal swelling which may be met with in the body, yet for scientific purposes its application is much more limited. A tumour may be defined as 'a mass of new formation that tends to grow or persist, without fulfilling any physiological function, and with no typical termination.' The fact that it has no typical termination distinguishes it from inflammatory overgrowths, which always lead sooner or later to the formation of fibro-cicatricial tissue or some modification of it; inflammatory growths, moreover, may disappear completely, and often diminish in size temporarily. Pure hypertrophies are excluded by this definition, since they always depend more or less on some increased physiological function, and are composed of an increased development of normal tissues, as, for instance, the blacksmith's biceps. Congenital overgrowth of a limb or portion of a limb also occurs, and is known as 'gigantism'; it cannot be considered a tumour, being merely an exaggerated development of normal tissues.

The **Ætiology** of tumours is still obscure, the most definite fact being that in a considerable number of cases (variously calculated at 7 to 14 per cent.) they follow and appear to be caused by some *injury* or *irritation*, which determines an abnormal development of some of the tissues of the part. Thus an adenoma of the breast is often attributed to a blow, and the irritation of a clay-pipe may produce epithelioma of the lip. In some cases the irritation may be due to chemical substances such as soot (in the case of chimney-sweeps), tar, or petroleum, all of which occasionally lead to the production of epithelioma in persons brought much into contact with them: except in these cases, *occupation* is not known to exercise any influence in the causation of tumours.

The question of *heredity* as a predisposing factor is still unsettled. It was formerly thought to be of considerable importance, but recent observations and statistics have not strengthened this view.

The *geographical distribution* of tumours has only been investigated in the case of cancer. The results of different series of observations have been fairly concordant, and tend to show that the disease is most common in low-lying, damp, well-wooded areas,

especially if they are liable to periodical floods, as, for example, the Thames Valley. It also seems proved that certain houses claim more than their average proportion of victims from cancer—in other words, that cancer is to a certain extent a house-disease. This has been taken to indicate an infectious origin for the disease, but other interpretations are possible.

The *age-incidence* varies with the type of tumour. Most innocent forms may occur at any age, though to this rule there are several interesting exceptions—*e.g.*, the adenomata of the breast, which grow only during the period of functional activity of the gland; the fibro-myomata of the uterus, which commence and grow only during the epoch of child-bearing; certain osteomata, which form exaggerations of normal tubercles of bone, and grow only whilst the bone grows; and some enchondromata, which arise from ossifying cartilage and continue their growth only during the activity of that structure—*i.e.*, until it becomes ossified. In the malignant tumours the age-incidence is better marked. Sarcomata occur at all ages, but are especially common in the first half of life, whilst carcinomata are very rare before the age of thirty, and are most common after the age of forty.

The effect of *sex* on the incidence of the innocent tumours and the sarcomata is not marked. Women are more liable to carcinomata than males, but this is in large measure owing to the frequency with which this disease attacks the uterus and female breast; cancer of the mouth and other portions of the alimentary canal is more common in men than in women.

Many theories have been brought forward to explain the **pathogenesis** of tumours, but the only ones that need be mentioned are the three following: (1) The **parasitic** theory rests partly on analogy with undoubtedly infectious diseases and partly on direct observation of the supposed parasite, and has been formulated chiefly for the malignant growths. There is at first sight a close clinical similarity between the infective granulomata, especially tubercle and cancer; in each there is a primary lesion marked by invasion and destruction of tissues, followed by secondary growths in the glands or internal organs, reproducing the structure of the primary focus. But the analogy is only superficial; the secondary tubercles are due to the carrying of the infective agents (the bacilli) in the blood or lymphatic stream to distant regions, where they are deposited, and continue to grow and give rise to an inflammatory reaction. The secondary nodules of cancer are caused by the transference in the blood or lymph of actual cancer cells derived from the primary tumour, which are deposited elsewhere, and continue their growth undisturbed, in spite of their change of environment. So-called 'cancer parasites' have been described by numerous pathologists, and have been identified as protozoa or as blastomycetes. They are now generally recognised as leucocytes or red corpuscles, which have entered cancer cells and undergone various forms of degeneration, or as portions of nuclei, paranuclei, etc. A few investigators claim

to have cultivated blastomycetes from cancers, and to have produced cancers by the injection of the cultures into animals, but these results have not been generally accepted.

Cancers are inoculable, but only into the same species of animal—*i.e.* cancers occurring in mice can be inoculated into mice, but not into other animals, and cancers in man are auto-inoculable (*e.g.*, epithelioma of one labium may infect the other by contact), but cannot be transmitted to the lower animals. This is not to be regarded as a proof of its infectious nature; the living cells which are transplanted continue to grow, just as they do in the formation of secondary growths.

2. The theory of **fœtal residues** was originated by Virchow's suggestion that in the ossification of cartilage small islets might be left, which subsequently grow and develop into enchondromata; the idea was at a later date expanded by Cohnheim to include all tumours. It certainly affords an explanation of some varieties of growth, such, for instance, as the dermoid cysts which originate in portions of epidermic structures left behind during embryonic development. But it is not a complete explanation, since it is obviously inapplicable to the formation of epitheliomata in scars; and even where it may apply, no reason is assigned why the embryonic 'rest' should suddenly take on renewed growth in after-life.

3. Kibbert's theory of **tissue tension** is especially applicable to the carcinomata, and attributes the initial defect to a weakness in the connective tissues in proximity to the epithelial cells, so that the latter are allowed to proliferate and invade the surrounding structures. The balance of evidence seems decidedly opposed to this theory, although it affords a satisfactory explanation of the frequency of carcinomata in advanced life, when the vitality and resisting power of the tissues may be assumed to be lowered.

Tumours may be divided into two great classes from a clinical standpoint, viz., the benign and the malignant.

Benign or **Simple Tumours** are characterized by the neoplasms being strictly local, by their more or less exact limitation, being frequently encapsuled, and by their method of growth, which results from a proliferation of all the cells constituting their structure. There is no tendency to infiltrate or invade surrounding tissues, which are merely pushed aside and compressed; pain and atrophy are sometimes caused by this pressure. The capsule is formed by an ensheathing layer of fibro-cellular tissue, the outcome of the chronic irritation and inflammation engendered by the growth and development of the mass; hence enucleation is easy, and recurrence uncommon. They are not unfrequently multiple, and may be hereditary; but these characters are no evidence of a constitutional taint.

Malignant Tumours, unless removed by operation, are almost invariably fatal. The following are the chief characteristics of malignancy: (1) The primary growth is usually single, rarely multiple. (2) It progresses steadily and constantly, but with

varying rapidity in different cases. (3) The local development is characterized by an infiltration of the surrounding tissues, which are gradually replaced by the tumour substance. A capsule is rarely formed, or, if at all, only in the early stages, and thus the limits of the growth are not clearly defined. Moreover, many varieties spread locally along the efferent lymphatics, and hence, although the growth may appear to have been completely excised, recurrences are very common, owing to the non-removal of these invisible extensions of the disease into apparently normal tissue. If a malignant tumour with all its ramifications is completely removed, it does not recur. The impossibility of knowing whether all the growth has been removed, or how far it has extended into the surrounding tissues, is responsible for the frequent recurrences. (4) When a malignant tumour invades the skin, it usually leads to ulceration and is very liable to septic infection, and then not uncommonly a foul fungating mass results (the *fungus hæmatodes* of the older pathologists). (5) Secondary deposits due to embolic dissemination of the cells of the growth are often found in neighbouring lymphatic glands or distant viscera. (6) An apyrexial cachexia develops in the later stages, partly due to the pain, partly to the pressure of the growth on important structures, and in part to the absorption of toxic products from the tumour. The patient becomes thin and emaciated, the face drawn and with an expression of pain on it; the appetite is impaired, and the skin often sallow and earthy-looking. (7) Finally, death ends the scene after a longer or shorter period of suffering.

The degree of malignancy varies with different tumours. In some the local phenomena predominate, whilst in others the constitutional symptoms are the more important. Thus, rodent ulcer is slow in its progress, and produces no visceral deposits; it destroys life merely by implication of vital parts. Melanotic sarcoma, on the other hand, may produce only a small primary growth, but the most extensively diffused secondary deposits may form in the viscera. The sarcomata are usually disseminated by the blood-stream, and hence secondary growths are not very common in lymphatic glands, whilst the carcinomata spread by means of the lymphatics. Even among the latter considerable differences are manifested; thus, in glandular cancer secondary growths occur both in the lymphatics and the viscera; whilst in squamous epithelioma neighbouring lymphatics are affected, but the viscera generally escape.

Recently it has been shown that there is a profound structural difference between malignant tumours on the one hand and benign tumours or inflammatory lesions on the other. The difference exists in the characters of the mitotic figures seen in dividing nuclei. These are of two sorts. In simple tumours and in inflammatory lesions the mitoses are of the somatic type—*i.e.*, similar to those occurring in the development of all the cells of the body other than the ova and testes. In malignant tumours there are some mitoses of this nature, but cells may also be seen which are undergoing

heterotype form of division, such as is only observed normally in the formation of the generative cells. The main difference is in the number of chromatin filaments, of which there are (in man) thirty-two in somatic mitosis, and sixteen in the heterotype form. In other animals other numbers occur, but the one is always exactly half of the other. These facts are as yet unexplained, but they are of profound theoretical interest in relation to the nature of malignant growths.

Classification of Tumours.—The following is a practical scheme of classification, based partly on the structure of the tumour, and partly on that of the tissue from which it originates.

I. **Tumours derived from the Connective Tissues:**

(a) Of embryonic type:
- Sarcoma.

(b) Of adult type:
- Myxoma (mucoid tumour).
- Lipoma (fatty tumour).
- Fibroma (fibrous tumour).
- Chondroma (cartilaginous tumour).
- Osteoma (bony tumour).
- Myoma (muscle tumour).
- Neuroma (tumour in connection with nerves).
- Glioma (tumour of neuroglia).

(c) Formed of combinations of simple tissues:
- Angioma (tumour composed of bloodvessels).
- Lymphadenoma, or lymphangioma (tumours of lymphatic origin).
- Odontoma (tumour connected with the teeth).

II. **Tumours composed Wholly or Chiefly of Epithelium.**—These may resemble papillæ or glands, or may infiltrate the connective tissue in a wholly irregular way, and hence may be subdivided as follows:

(a) Tumours resembling papillæ:

Papilloma
- Squamous-celled.
- Cuboidal-celled.
- Columnar-celled.

(b) Tumours resembling glands:

Adenoma
- Cuboidal-celled.
- Columnar-celled.

(c) Atypical tumours:

Carcinoma
- Squamous-celled (epithelioma).
- Cuboidal-celled (glandular carcinoma).
- Columnar-celled.

III. **Tumours growing from Endothelium:**
- Endothelioma.

IV. **Tumours formed by the Inclusion of Part of another Embryo:**
- Teratoma.

I. The Connective-Tissue Group of Tumours: (1) Tumours composed of Embryonic Connective Tissue.

Sarcoma (= a flesh-like tumour; Greek, σαρξ, flesh).—A sarcoma is a malignant tumour which is derived from connective tissue. Like all tumours, it consists of a parenchyma, formed of cells which have taken on the power of continued and apparently limitless growth, and of a more or less inert supporting network or stroma consisting of fibrous tissue, bloodvessels, etc. It is characteristic of the sarcomata that these two elements are intimately mingled together, each parenchyma cell being separated from its neighbours by delicate fibrillæ of the stroma; in the other great group of malignant tumours (the carcinomata) this is not the case, since the parenchyma cells occur in masses or alveoli which are enclosed by, and sharply marked off from, the stroma. The parenchyma cells of the sarcomata are of mesoblastic origin, and resemble the cells from which the connective tissues are formed in the embryo both in shape and in their capacity for continued growth; hence they are often referred to as embryonic connective-tissue cells. There is, moreover, a great resemblance between the sarcomata and inflammatory new formations, which are also composed of mesoblastic cells which have assumed the power of growth; and this resemblance is increased by the fact that in both cases these embryonic cells may undergo organization into more mature forms of connective tissue, such as fibrous tissue or bone. There is, however, this marked difference between the two: the inflammatory new formations arise as the result of a definite irritant, and cease to spread when that irritant ceases to act; whereas the sarcomata usually arise without apparent cause, and continue to spread indefinitely.

A sarcoma may at first be well defined or even encapsulated; but many forms from the first, and all later on, infiltrate the surrounding tissues, replacing them with their own particular structure, a process which can be well observed in sarcomata of muscles. The *blood-supply* is very abundant, and, indeed, may be so free as to cause the tumour to pulsate. The vessels consist of spaces or clefts within the tumour substance, and are lined merely by the most delicate endothelium; the arteries and veins in the neighbourhood are much dilated. Interstitial hæmorrhage is frequent, owing to the thinness of the vessel walls, and cysts may in this way be produced. *Dissemination* is usually dependent on the relation of the tumour to the veins. As already stated, the veins communicate with spaces hollowed out of the tumour substance; into and along these the sarcomatous tissue may burrow, until the apex of this intravascular growth projects into the lumen of a vessel in which the blood is freely circulating. It may be detached by some slight mechanical injury, and is then carried away as a malignant embolus; if a large portion is set free, it may lodge in the right side of the heart, or in the lungs, and cause a fatal result. Smaller emboli are either detained in the lungs, or pass through into the general circulation, giving rise to

secondary growths wherever they are arrested; it is quite usual for general visceral implication to be secondary to the pulmonary growths. Nothing is known as to the existence of nerves or lymphatics in sarcomata; occasionally, however, dissemination by way of the lymphatic glands is met with, especially in melanotic sarcoma, lympho-sarcoma, and sarcoma of the tonsil, testis, and thyroid body.

The various forms of sarcomata described below have a tendency to become organized into tissues which bear a close resemblance to the normal connective tissues, and tumours in which this process has taken place to a marked extent often receive special names, *e.g.*, fibro-sarcoma, in which the parenchyma cells become organized into fibrous tissue; osteo-sarcoma, in which they develop into bone; chondro-sarcoma; and lipo-sarcoma.

Degenerative changes are also apt to occur in the older portions of a sarcoma, but not at the spreading edges, so that the malignancy of the tumour is not thereby affected. Fatty degeneration is the commonest, and leads to the formation of a tumour, which must be distinguished from a lipo-sarcoma; mucoid softening may also take place, and tumours in which this has happened are often known as myxo-sarcomata. Hæmorrhage is frequent into the softer varieties, and calcification is not unfrequent in the more chronic forms.

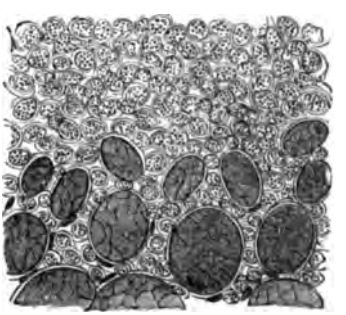


FIG. 32. SMALL ROUND-CELLED SARCOMA INFILTRATING MUSCULAR TISSUE. (TILLMANNS.)

On naked-eye examination, a sarcoma presents a more or less homogeneous appearance, the colour varying with the amount of the blood supply, from a grayish-white in the fibro-sarcomata to a deep maroon colour in the myeloid. On scraping the cut surface, juice, like that from a cancer, is never obtained, even when the tumour has been removed from the body for some time, and thus the cohesion of the cells impaired; a milky substance then sometimes appears, whilst in myeloid sarcoma a slimy fluid escapes, but it in no way resembles that obtained from a cancer.

This form of malignant disease occurs most commonly in young and middle-aged people, especially affecting the first and fourth decades of life; it may also be congenital. The degree of malignancy varies considerably, some forms being almost benign, or, at any rate, only locally malignant, whilst others are exceedingly virulent in nature.

Sarcomata are divided artificially into the following groups, depending on the size, shape, arrangement, and character of the constituent cells: (*a*) The round-celled; (*b*) the spindle-celled; (*c*) the myeloid; (*d*) the alveolar; and (*e*) the melanotic.

(*a*) **Round-celled Sarcomata** (Fig. 32) consist of a mass of round cells containing a very definite circular or oval nucleus; the intercellular substance is slight in amount, and often homogeneous in character. The mass is very vascular, and may even pulsate; it is soft, like granulation tissue, and usually grows rapidly. Several subdivisions are described: (i.) The *small round-celled sarcoma* is extremely malignant, infiltrating surrounding parts, and early giving rise to secondary deposits; lymphatic glands are not unfrequently affected in this variety. The small size of the cells is thought to be an indication of the rapidity of growth, since they divide before having time to grow to a large size. Any part of the body may be involved, and it may be met with at any age. (ii.) The *large round-celled sarcoma* is made up of larger cells, which contain one or two large oval nuclei with an abundant protoplasm around. A well-marked stroma is interspersed between the cells, and an alveolar arrangement is sometimes present; it occurs in the same position as the former, but is rather less malignant. (iii.) *Lympho-sarcoma* is

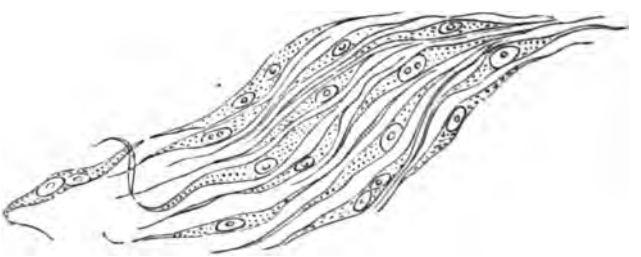


FIG. 33.—SPINDLE-CELLED SARCOMA.
The individual cells have been separated, and the characteristic nuclei can be seen.

very similar in structure; the cells, however, are small, and the intercellular substance is of a delicate reticular nature, corresponding to the retiform tissue commonly met with in lymphatic glands. Such tumours grow rapidly, and are exceedingly malignant; they usually start in lymphatic glands, or in the lymphoid tissue of mucous membranes, and are disseminated by means of the lymphatics. For the clinical characters of these tumours, see Chapter XIV.

(*b*) **Spindle-celled Sarcomata** (Fig. 33) consist of large or small spindle cells, which are often arranged in a somewhat fasciculated manner with a greater or less amount of intercellular substance. When consisting of *small cells*, the tumour grows rapidly, and is firmer and less succulent than the round-celled variety. They may originate in any part of the body, but more especially from aponeuroses, fasciæ, tendons, etc., constituting localized growths, which are at first tolerably well defined, but later on invade and infiltrate surrounding parts. When growing rapidly, the cells become less fusiform in

shape, and may even approach to the round cell in character, after passing through a stage known as the oval or oat-shaped sarcoma. These tumours, consisting of small spindle cells, are usually very malignant in character. In some cases the cells undergo organization into well-formed fibrous tissue, and the tumour closely resembles a simple fibroma, being well encapsuled, so that it can be shelled out with ease. These tumours are known as fibro-sarcomata ('recurrent fibroid' tumours of Paget), and are not uncommon in the subcutaneous tissues. They are on the border-line of malignancy, since they rarely form secondary growths, and often do not return for two or three years after removal. But they usually recur more rapidly

FIG. 34.—MYELOID SARCOMA, SHOWING THE MULTI-NUCLEATED MYELOID CELLS (MYELOPLAXES) LYING AMONGST THE MORE ABUNDANT SPINDLE CELLS. (GREEN'S 'PATHOLOGY.')

after each operation and show signs of greater malignancy, until, after, perhaps, being removed a dozen times, they recur with all the characters of an ordinary spindle-celled sarcoma.

The *large spindle-celled sarcomata* are softer and of a deeper colour than the former. They grow from the fibrous tissues, and not uncommonly from the viscera. The congenital sarcoma of the kidney is of this nature, though some of the cells become transversely striated, looking like muscle fibres; such tumours are sometimes called 'myo-sarcomata.'

(c) **Myeloid Sarcomata** (Fig. 34) are characterized by the presence of large numbers of multi-nucleated giant cells (*myeloplaxes*), imbedded in a considerable quantity of round or spindle cells, the intercellular substance being usually of a gelatinous nature. The

myeloid cells vary a good deal in size, but always contain a large number of distinct nuclei, which are not distributed regularly in the periphery of the cell, as in the case of the giant cells of tubercle; they may be regular in outline, or prolonged into numerous interlacing processes, although these latter are usually not very evident. There is also no definite arrangement of cells around them, as in the tubercular giant-cell systems. These tumours are soft in consistency, and on scraping a slimy fluid is obtained. They are exceedingly vascular, and may pulsate. Hæmorrhage into their substance is common, giving rise to cysts, filled with serum and a yellowish fibrinous clot stained with the colouring matter of the blood. When fresh, the growing edge is of a dark maroon colour on section, and has been likened to the appearance of a pomegranate; when preserved in spirit, these tumours are always of a characteristic brown colour, owing to the formation of hæmatin. They are the least malignant of all the sarcomata, but rarely or never giving rise to secondary deposits, either in the lymphatic glands or viscera. Their growth is tolerably rapid, and they may attain enormous dimensions. Myeloid sarcoma is almost invariably found growing from bones; for the particular sites, symptoms, and treatment, see Chapter XX. A certain amount of doubt exists as to whether these tumours should be included amongst the sarcomata, since their clinical history and progress are of a benign type, and the term 'myeloma' has been suggested for them, as indicating in measure their nature and structure.

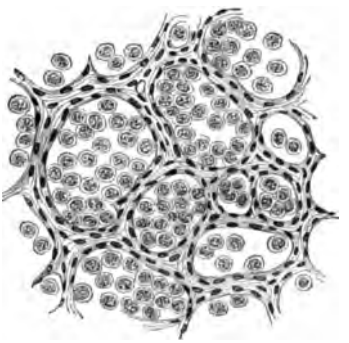


FIG. 35.—ALVEOLAR SARCOMA. (TILLMANNS.)

The individual cells in the alveoli are here apparently lying in close contact, but in reality there is a certain amount of intercellular substance placed between each of them.

(*d*) **Alveolar Sarcoma** (Fig. 35) is a variety in which the cells are grouped together in alveoli, separated by a distinct fibrous stroma. On microscopic examination they closely resemble cancer; but on carefully pencilling a section with a camel's-hair brush, it will be found that the stroma sends delicate prolongations between each of the cells. This variety of tumour is most commonly found growing from the skin, and is occasionally of a melanotic nature, and always very malignant.

(*e*) **Melanotic Sarcoma** is the most virulent of all this group of tumours, because of the early date at which it forms secondary deposits in lymphatic glands and internal organs. It grows from those portions of the body which are naturally pigmented, especially the choroid coat of the eye and the skin. Those growing from the former situation are usually composed of spindle cells, all of which contain granules of melanin; these choroidal tumours are true

sarcomata, and have a special tendency to form secondary deposits in the liver. The melanotic tumours of the skin most frequently develop from pigmented moles. They have an alveolar structure, and were formerly regarded as alveolar sarcomata, but most pathologists now follow Unna in regarding the tumour cells as being derived from downgrowths of the surface epithelium, and classify the tumours themselves as carcinomata. The pigment granules in this form are very unevenly distributed, some lying in the stroma between the alveoli, whilst others are contained in the cells; some portions of the primary tumour are often quite free from pigment, and some of the secondary growths are often colourless, whilst adjacent growths may be absolutely black. The nature of the pigment (melanin) is still uncertain, but the fact that it does not contain iron seems to indicate that it is not derived from hæmoglobin. It may be deposited in the skin of the patient apart from the tumours (melanosis), or may be excreted in the urine.

If the primary tumour is not removed very early, the nearest lymphatic glands are soon affected, and secondary deposits in the viscera follow. The original tumour is often not very large, and the secondary deposits are similarly characterized by their number rather than by their size, scarcely an organ in the body being free.

Of late years a more benign type of melanosis has been described, and is now well recognised by dermatologists. It usually spreads from a congenital mole as a deeply pigmented patch, which may extend over an area of several square inches, and presents at first no sign of induration or infiltration; in this stage microscopic examination reveals no change in texture except pigmentation of the deeper layers of the cutis vera. Sooner or later, a tumour develops in the centre of this patch, and may be either a sarcoma or a cancer, but more frequently the former. It is not very rapid in its course, but if left alone will finally become disseminated. In treating this type of melanosis, it is essential to remove every portion of pigmented tissue as well as the tumour.

The **Treatment** of sarcoma consists in its removal as early and completely as possible. This may be a simple matter in cases where the tumour is encapsuled, but even then recurrence is very likely to follow unless the capsule is also taken away, and a considerable margin of tissue beyond it. Where, however, the growth is more diffuse, the only hope lies in cutting widely, so as to get beyond its furthest limits; the prognosis of such cases is very bad.

In hopelessly *inoperable* cases somewhat similar measures have been employed as for the similar stage of cancer (*vide* p. 210). Several cures have now been recorded from the use of Coley's fluid, which consists of a sterilized culture of the *Streptococcus erysipelatis* and *Micrococcus prodigiosus* in bouillon. This fluid is intensely toxic, and the injections, commencing with doses of half a minim, are gradually increased up to 7 or 8 minims; severe reaction usually follows, and the surgeon should aim at obtaining two or three such effects each week. The fluid is introduced partly into the abdominal wall, and partly into or around the tumour. In favourable cases the growth gradually dwindles. The spindle-celled sarcomata are

apparently the most suitable for this treatment, whilst ossifying and melano-sarcomata are but little, if at all, affected. As to the value of X rays for sarcoma, see p. 210.

(2) Tumours consisting of Connective Tissue of Adult Type.

Myxoma.—A myxoma is a tumour consisting of connective-tissue cells, surrounded by and separated from each other by an intercellular substance of a mucoid character; a similar type of material occurs normally in the substance of the umbilical cord. The cells are usually polygonal in shape, and present long branched processes which interlace with those from adjacent cells (Fig. 36). The intercellular substance is homogeneous and translucent, containing

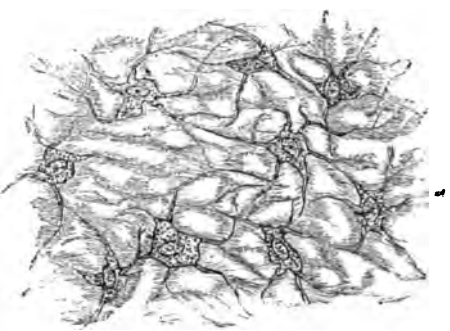


FIG. 36.—MYXOMATOUS TISSUE, SHOWING THE STELLATE CELLS, WITH THEIR BRANCHING PROCESSES SEPARATED BY TRANSLUCENT INTERCELLULAR SUBSTANCE. (TILLMANNS.)

wandering connective-tissue corpuscles, and traversed by blood-vessels; the density of the tumour varies inversely with the amount of intercellular substance. It is not uncommon for this form of growth to be associated with sarcoma, and hence a thorough and early removal of the mass is always advisable.

Myxomata occur as rounded tumours, perhaps lobulated, in the neighbourhood of mucous membranes—*e.g.*, the face, intestine, and bladder; they also grow in the sheaths of nerves, and are the commonest form of simple tumour of the spinal cord. Mucous polypi of the nose were formerly considered of this nature, but at the present time rhinologists look on them as merely consisting of œdematous granulation tissue.

Lipoma.—A fatty tumour is an overgrowth of fibro-cellular tissue, infiltrated with fat. On microscopical examination it differs in no respect from ordinary adipose tissue, and is not very freely supplied with bloodvessels.

When **localized** (Fig. 37) it forms a tumour, soft and semi-fluctuating in consistence, rounded and lobulated in outline, and if

occurring in the subcutaneous tissues, the skin becomes dimpled on moving it from side to side, owing to the fact that fibrous trabeculæ pass from the capsule to the skin. The growth is usually encapsuled and freely movable; but if exposed to pressure or friction, as when situated on a man's shoulder and rubbed by the braces, it becomes firmly adherent to surrounding structures. Such growths are either single or multiple, in the latter case perhaps occurring in hundreds, and are most commonly found about the trunk or the upper extremities. It has been stated that lipomata travel from one part of the body to another under the influence of gravity, but it is somewhat doubtful whether this ever occurs. Occasionally subcutaneous tumours become pedunculated and pendulous.

FIG. 37.—LIPOMA, SHOWING CHARACTERISTIC LOBULATED OUTLINE. (FROM KING'S COLLEGE HOSPITAL MUSEUM.)

Deep intermuscular lipomata are sometimes met with, and the diagnosis may then be uncertain, since their mobility and lobulated outline are masked by the superjacent tissues; they have even been mistaken for sarcomatous growths. Still more difficult of recognition are those known as **parosteal lipomata**, growing from the outer surface of the periosteum. They are often congenital, and appear as soft swellings, lying beneath the muscles in close proximity to a bone and suggesting the presence of a chronic abscess.

Pericranial lipoma is of a somewhat similar nature. It is usually congenital in origin, and the cranium may be hollowed out beneath it. An angiomatous element is sometimes present in these growths.

By the term **Diffuse Lipoma** (Fig. 38) is meant a fatty infiltration of the subcutaneous tissues of some region of the body, particularly beneath the chin and at the back of the neck, and more rarely in the pubic region. These growths are often multiple and almost always symmetrical. They usually occur in individuals who drink beer freely and take but little exercise. Their size diminishes on limiting the amount of alcohol and making the patient do physical work.

Occasionally the connective-tissue basis of a lipoma undergoes modifications; *e.g.*, it may become increased in amount, constituting a **Fibro-lipoma**, or be transformed into mucoid tissue, giving rise to a **Myxo-lipoma**; or, again, the vessels may become dilated, originating a **Nævo-lipoma**; and even a **Sarco-lipoma** may develop.

Localized or diffuse overgrowths are often met with in t peritoneal fatty tissue, constituting **Subserous Lipomata.** occur not unfrequently in the lower part of the abdomen, s extend into the inguinal and crural canals, forming the s fatty tumour in these parts. By their traction a process toneum may eventually be drawn down, and a true hernia p

FIG. 38.—DIFFUSE LIPOMA.

A similar condition o the anterior abdomin small pedunculated m fat projecting throug genital or acquired ope the linea alba or line lunaris; these are so known as **Fatty Herni Linea Alba,** and are oft ful.

Lipoma Arborescens term applied to a vill growth of fatty tissue, s in the interior of joi usually associated wit arthritis. There is considerable increase amount of intra-articul and the condition h been designated 'synov matosus.'

The **Treatment** of consists in their When they are loosely suled, this is a very matter, all that is req many cases being to squeeze the mass forwards betw thumb and finger, making the skin tense over it, and then the capsule freely, when the tumour almost jumps out; but are many adhesions it may not be so easy. In the *diffu* dietetic and hygienic measures should first be tried. Sh operation be required, it is well to cut through the whole t of the tumour at once, and deal with each half separately, di it away from its deep attachments.

Fibromata consist of overgrowths of fibrous tissue; th formerly divided into two groups, the **hard** and the although there is no essential difference between them, it is clinical distinction.

The **Hard Fibroma** is composed of firm dense tissue, whic on section with the knife, the exposed surface showing m trabeculæ of glistening fibres, similar in character to those s in a tendon (Fig. 39). Microscopically, interlacing fibrillæ

which are sometimes arranged concentrically around the blood-vessels; there are but few nucleated cells in the more slowly growing tumours. The vascular supply is somewhat defective, although dilated veins are often present in the capsule, and sometimes in the substance of the mass; these, if opened by ulceration, may lead to profuse haemorrhage. Hard fibromata are met with in the form of *epulis*, *fibrous polypus of the nose*, *keloid*, and not uncommonly in the sheaths of nerves.

Soft Fibromata develop as localized overgrowths of the subcutaneous fibro-cellular tissue, or as the so-called **Molluscum fibrosum**. In the latter case many different forms of the growth are met with; sometimes many small nodules develop, scattered widely

FIG. 59.—SECTION OF HARD FIBROMA. (ROYAL COLLEGE OF SURGEONS' MUSEUM.)

over the surface, usually pinkish, and with the skin over them somewhat corrugated; these may be associated with changes in the underlying nerves (p. 196). It also exists in the form of pendulous folds, perhaps involving a large area of the trunk; the so-called pachydermatocele of the scalp is of this nature.

Chondroma.—Cartilaginous tumours are met with growing in connection with either bones or cartilages. They consist of hyaline cartilage, which, instead of being uniform in texture and devoid of vessels as at the articular ends of bones, occurs in the form of pellets or nodules of varying size, held together by vascular connective tissue, which may even penetrate into the substance of the

cartilage. The cells are also less regular in shape than is the case with normal cartilage, and are not arranged according to any definite plan.

Chondromata are liable to become calcified, and even ossified. When large, the central parts may undergo a mucoid change, giving rise to a cavity which, if sepsis is admitted, becomes exceedingly foul. They are not uncommonly accompanied in their growth by sarcomatous and other elements.

When growing *from the long bones*, chondromata usually start from beneath the periosteum, and are independent of the epiphyseal cartilage, although it has been suggested by Virchow that they may originate from a nodule of cartilage which has been displaced from its usual situation during an attack of rickets. They constitute firm lobulated encapsuled tumours, and give rise to no pain, except when they encroach on neighbouring nerves. They often attain a great size. The growth may extend secondarily into the medullary canal, and thus cause expansion of the bone; or it may erode the compact tissue, and lead to spontaneous fracture. Amputation of the limb will probably be necessary, unless the case comes under observation in the early stages, when the tumour can be gouged or scraped away.

Chondromata also originate *from the smaller bones*, usually from those of the hand (Fig. 40). In such cases the growth commences in the interior, close to the epiphyseal cartilage; several tumours may be present in the same individual. The bone is expanded by the growth, and the part becomes much deformed. Treatment consists in incising the capsule, and scooping out the cartilaginous tissue, a proceeding which may result in defective growth and subsequent deformity. In the later stages, however, amputation is inevitable.

FIG. 40.—MULTIPLE CHONDROMATA OF THE FINGERS.

Overgrowths of cartilage, known as **Ecchondroses**, occur around the articular cartilages in connection with osteo-arthritis; they also arise from the cartilages and septum of the nose, and from the laryngeal cartilages. Some of the loose bodies which form in joints are of a similar nature.

Osteoma.—Bony tumours are of two chief forms: the cancellous and the ivory.

Cancellous Osteomata are usually met with growing near the articular end of a bone, being derived originally from some isolated portion of the epiphyseal cartilage, which has perhaps been separated from its original connection after an attack of rickets. It is well known that in this affection irregular outgrowths from the epiphyseal cartilage occur, and if one of these near the periphery of the bone

PLATE II.

EXOSTOSIS OF THE RADIUS.

This growth occurred in a young man aged twenty-three years. It will be noticed that it has caused great deformity of the ulna, and, indeed, apart from the skiagram, one might have supposed that it had originated from that bone.

becomes shut off from its epiphyseal attachment, it is easy to understand its development into a tumour, which consists of cancellous bone, capped by a layer of hyaline cartilage, from which it grows (Fig. 41). It is pedunculated or sessile, and may attain to a large size, leading to considerable deformity (Plate II.). It necessarily develops in young people, and may be congenital. As the individual grows, the basis of attachment may become separated from the epiphysis to an extent corresponding to the amount of growth which has taken place at that spot, or it may still remain attached to the epiphyseal line. As a rule its growth and development cease at maturity, when the cartilage covering it, as well as the epiphyseal

FIG. 41.—SEMI-DIAGRAMMATIC REPRESENTATION OF CANCELLOUS EXOSTOSIS OF THE UPPER END OF THE TIBIA. (FROM A SKIAGRAM.)

The patient had many other exostoses, including one growing from the neighbourhood of the adductor tubercle of the femur, and another from the outer side of the head of the tibia in front of the fibula, which has been omitted in the diagram. The cartilaginous cap covering the cancellous tissue is clearly indicated.

FIG. 42. SUBUNGUAL EXOSTOSIS. (BLAND SUTTON.)

cartilage ossifies. A bursa occasionally forms over the most prominent part of these tumours as a result of friction or pressure, giving rise to the condition known as **Exostosis Bursata**; this cavity may communicate with the joint. An effusion of blood or serum into the bursa may be the first evidence of the existence of such a growth. Multiple exostoses are not unfrequently met with, and are then often hereditary. The most common situation for such a tumour is the inner condyle of the femur, close to the adductor

tubercle, but they are not rare on the inner aspect of the mandible. The **Subungual Exostosis** (Fig. 42) develops as a rounded, cherry-like swelling under the nail of the great toe. It is very painful, and should be treated by removing the nail, incising the tissues over it down to the bone, and clipping it away with cutting pliers. Fig. 43 represents a skiagram of an exostosis growing from the proximal phalanx of the thumb.

Ivory Exostoses develop most frequently on the inner or outer aspect of the cranial bones, especially affecting the orbit, external auditory meatus, antrum, and frontal sinus (Fig. 44). They consist of masses of very dense compact tissue, covered by periosteum, from which they grow. They are usually lobulated, and when situated in the frontal sinus, or growing from the under surface of the skull, may give rise to serious symptoms from irritation or compression of the brain or its membranes. In a few cases necrosis has resulted, and they have sloughed out, thus bringing about a spontaneous cure.

FIG. 43.—SKIAGRAM OF EXOSTOSIS GROWING FROM THE BASE OF PROXIMAL PHALANX OF THUMB, SHOWING OPEN CANCELLOUS TEXTURE AND ORIGIN NEAR THE EPIPHYSEAL CARTILAGE.

Occasionally diffuse overgrowths of the bones of the skull (**Hyperostoses**) are met with, affecting either the calvarium alone, being then probably syphilitic in nature, or the facial and cranial bones, as in leontiasis ossea. New formation of bone sometimes occurs in the substance of tendons which are exposed to irritation or excessive action, *e.g.*, the tendon of the adductor longus in riders, producing what is known as 'the rider's bone,' but this is inflammatory in origin.

The **Treatment** of osteomata consists in their removal where possible. This may be tolerably simple in the case of the cancellous osteomata of the limbs, but is sometimes a most formidable proceeding when dealing with sessile compact exostoses of the calvarium.

Myoma.—Myomata almost always consist of *unstriped* muscle fibres (**Leiomyoma** or **fibromyoma**), forming rounded and often encapsuled tumours, the cells of which are long and fusiform, and contain a rod-like nucleus. Bundles of these cells are grouped together into fasciculi, which are arranged more or less regularly. The tumours themselves are not very vascular, but vessels of considerable size are found in the capsule. It is often difficult to distinguish these tumours microscopically from fibromata on the one hand, and from fibro-sarcomata on the other. From the former they are known by the fact that individual cells can be recognised, and by the absence of wavy tendinous fibrillæ;

from the latter the distinction depends on the facts that other types of tissue may occur in the sarcoma, and that the growing edge is usually more or less embryonic in character, whilst a myoma is of the same structure throughout. Again, in a myoma the blood-vessels have distinct and definite walls, and in a sarcoma they are simply clefts or passages in the tumour substance.

Myomata are met with in the uterus, occasionally in the prostate, and more rarely in the walls of the alimentary canal or in the ovary. Secondary changes sometimes occur, *e.g.*, mucoid softening, as in fibro-cystic disease of the uterus, calcification, ulceration with profuse hæmorrhage, and possibly consequent septic inflammation, whilst malignant disease may supervene.

Tumours consisting of *striped* muscle fibres (**Rhabdomyoma**) have been described, but are exceedingly rare.

Fig. 14.—Ivory Exostosis growing from Frontal Sinus, and encroaching both on the Orbit and the Cranial Cavity. (Bland Sutton.)

(From specimen in the College of Surgeons' Museum.)

Neuroma.—True Neuroma is seldom met with, only five undoubted cases being on record. It is formed by a mass of newly-formed ganglion cells and nerve fibres, which may be medullated or not. In all but one case it involved the sympathetic system, and occurred in children or young people. The tumours may attain considerable dimensions, are often multiple, and may be quite soft, like a lipoma, or firm. They are insensitive and innocent, and may be freely removed.

False Neuromata, or those developing in connection with the sheaths of nerves, are more common, and may be described under three headings:

1. **Localized Pseudo-Neuroma**, which may be innocent or malignant, the former being a fibroma or myxoma, the latter usually a

sarcoma. It may project from one side of the nerve, or more frequently causes the nerve fibres to be separated and spread out over it (Fig. 45). It moves more freely in a direction at right angles to the axis of the nerve than along its course. When developing from a small nameless subcutaneous twig, it is termed a ***painful subcutaneous nodule***, and then gives rise to intense pain of a neuralgic type, especially when compressed or irritated, or when exposed to cold. A false neuroma growing from a larger mixed nerve (***trunk neuroma***) is less painful, because there are relatively fewer nerve fibrillæ, and the mass is less exposed. A growth on a pure motor nerve, though sensitive, is not associated with radiation of pain. It is uncommon for tumours of this type to cause complete paralysis or anæsthesia, unless they are of a malignant nature. They occur most frequently in healthy adults, and in women a little more commonly than in men.

FIG. 45.—PSEUDO-NEUROMA: FIBROUS TUMOUR GROWING FROM NERVE SHEATH, AND CAUSING THE FIBRES TO BE WIDELY STRETCHED OVER IT.

Treatment.—A neuroma, if painful, should be removed, care being taken, if possible, not to interfere with the continuity of the nerve fibrillæ. If this cannot be accomplished, the nerve must be divided, and the ends sutured together.

2. **Diffuse or Generalized Neurofibromatosis** (*Recklinghausen's disease*).—This consists of a diffuse thickening of the nerve sheaths, causing multiple elliptic or spherical tumours, or a generalized enlargement. The growths may be encapsuled and limited, or not; they may be few in number, or hundreds may be present, and they are usually whitish and firm in texture. They originate from the endoneurium of the primary nerve bundles. Any part of the peripheral nervous system may be affected, including the sympathetics, but it is most common in connection with the cranial nerves and the large plexuses of the trunk. The actual symptoms are sometimes very slight, but the tumours may be sensitive to pressure, and some one of them, more exposed than the others, may be exquisitely tender. Motor phenomena are rare, and paralysis is usually due to involvement of the nerve roots in the spinal canal, or to the supervention of sarcoma, which is a not uncommon termination. The disease may start at any time during life, and although progressing slowly, sooner or later terminates fatally. No known *treatment* is of any avail, but should any particular tumour become large and tender, it may be removed.

In connection with this disease one frequently finds a large development of fibrous growths of the skin, similar to what we

have already described as molluscum fibrosum. On careful microscopical examination of specimens stained by Weigert's method, the presence of nerve fibrillæ can be demonstrated in these growths, showing that they are really neuro-fibromatous in origin. So excessive does this overgrowth occasionally become that a form of elephantiasis is produced, *e.g.*, the irregular hyperplasia of the scalp tissues known as a *pachydermatocele*.

Plexiform Neuroma is a special modification of this process, occurring congenitally or in young people, and usually involving the trigeminal or superficial cervical nerves; it may be associated with the former condition. The overgrowth is of a softer, more gelatinous type (myxo-fibromatous), and the resulting tumour consists of a plexus of thickened, tortuous, vermiform strands, of soft consistence, held together by loose connective tissue, but easily separable into their constituent elements, which are of a nodulated character, so that the dissected mass looks 'not unlike grains of boiled tapioca on a string' (Alexis Thomson). The plexiform neuroma is almost always subcutaneous, but often dips deeply between and into the substance of muscles. When limited in extent, the growth may be dissected out, and this is usually required for cosmetic purposes. The final prognosis is rather better than in the former condition, as secondary sarcomatous changes are rare.

3. The bulb formed upon the proximal end of a nerve after its division is sometimes described as a neuroma (**Traumatic Neuroma**). It consists of a mass of fibro-cicatricial tissue containing spaces, rolled up within which are numbers of newly-formed axis cylinders (p. 372). They are almost always present in amputation stumps, but are not painful unless adherent to the periosteum of the neighbouring bone, or to the cicatrix, when every movement of the nearest joint causes traction upon them, and induces severe neuralgia.

Gliomata are tumours arising from the neuroglia of the central nervous system or retina, and, unlike the tumours described above, are of epiblastic origin. They are most common in the brain and spinal cord, and are very rare in the retina, most of the growths occurring in this region, and supposed to be gliomata, being in reality round-celled sarcomata; the distinction is one of some importance, since the true glioma never gives rise to secondary growths (although it may infiltrate locally), and is completely removed with ease, so that recurrence is uncommon. They consist of cells (which may be round, spider-shaped or spindle-shaped) and of fibres; these occur in varying proportions in different cases, giving rise to the hard and soft varieties. Their colour often closely resembles that of the brain itself, and there is usually no sharp line of distinction between the tumour and the surrounding tissue, so that they were formerly regarded as malignant and termed glio-sarcomata. They vary greatly in rapidity of growth and in vascularity.

(3) Tumours formed of Combinations of Simple Connective Tissues.

Angioma.—Several distinct varieties of tumour consisting of dilated arteries or veins exist, but the term 'angioma' is applied only to those in which a new formation of bloodvessels occurs; hence aneurisms and varicose veins are not included in this category.

Three main types of angioma may be described: (1) The simple nævus; (2) the cavernous nævus; and (3) the plexiform angioma.

The **Simple Nævus** is exceedingly common, and consists of a mass of dilated capillaries, bound together by a small amount of connective tissue. It is usually congenital, and may increase rapidly in size during the first few months of life. It is located in the skin, or may also involve the subcutaneous tissues, but the tubular form

FIG. 46.—SECTION OF CAVERNOUS ANGIOMA. (MUSEUM OF ROYAL COLLEGE OF SURGEONS.)

In one or two of the cavernous spaces thrombi more or less adherent can be seen.

of the constituent vessels always remains. It may be of a bright red colour or of a dusky tint. For a fuller account, see Chapter XIII. If untreated, simple nævi may persist unchanged, or may disappear; in a few instances they increase rapidly in size, either early or late in life, sometimes giving rise to a considerable vascular growth, purplish in colour, and occasionally becoming prominent and pendulous. Such a tumour is soft and easily compressible, being in reality a cavernous angioma; it may ulcerate, and profuse hæmorrhage may result. *Treatment* consists in electrolysis, if excision is impracticable.

The **Cavernous Nævus** consists of dilated spaces, where the tubular form of the constituent vessels is lost, the arteries usually opening directly into thin-walled cavities lined with endothelium without the intervention of capillaries (Fig. 46). The tumours are thus more or less erectile in nature, somewhat resembling the corpus

cavernosum. They are met with in the skin and subcutaneous tissues, constituting diffuse or circumscribed tumours of a reddish-blue colour, which can be emptied on pressure, but rapidly refill when such is removed, and in which pulsation is occasionally present. A similar condition arises in the viscera, especially the liver, and then is always acquired, and it is not difficult in suitable cases to demonstrate that it has been formed by a dilatation of the capillaries between the lobules, the liver substance meanwhile disappearing by a process of simple atrophy. Occasionally a cavernous angioma undergoes spontaneous cure as the result of some inflammatory affection similar in nature to phlebitis, a non-vascular fibro-cystic mass remaining.

Under the term **Plexiform Angioma** may be included the cirsoid aneurism, or aneurism by anastomosis, the former term being applied by some authors to tumours consisting of large vessels, and then most commonly seen about the scalp and face, and the latter to aggeries of small vessels. The treatment is always a matter of considerable difficulty (see Chapters XX. and XXV.).

Lymphadenoma and Lymphangioma.—The primary tumours developing in connection with lymphatic glands and vessels are described in Chapter XIV.

Odontoma.—Tumours originating from some abnormal condition of the teeth or teeth-germs are known as 'odontomes.' Bland Sutton, in his work on tumours,* has described seven different varieties, several of which are, however, rarely met with in man. We can only deal here with the more important of these, and must refer our readers to Chapter XXVII. and to Sutton's book for a fuller description. (1) **Epithelial Odontome.**—In this condition, formerly known as 'fibro-cystic disease of the jaw,' the mandible is most commonly affected. A tumour forms, consisting of spaces lined by epithelium, which are developed as irregular outgrowths from the enamel organ. It occurs most frequently in young people, and may give rise to a growth of enormous size. (2) **Follicular Odontomes**, or, as they are often termed, 'dentigerous cysts,' are produced by the development of a cavity around a misplaced or ill-developed tooth of the permanent set, which often lies horizontally, so that its eruption is impossible. (3) **Fibrous Odontomes** are the result of a thickening and condensation of the connective tissue around a tooth sac. They are most frequently observed in the lower animals, but are also said to occur in rickety children. (4) **Radicular Odontome** is the term applied to a tumour composed of cement, developing at the root of a tooth. It gives rise to severe pain, and may result in septic inflammation of the surrounding bone. (5) **Composite Odontomata** consist of a conglomeration of the various forms of tissue entering into the formation of a tooth, and developing in the neighbourhood of the jaw. They may be very large, and

* Bland Sutton, 'Tumours and Cysts.' Cassell and Co.

probably some of the bony tumours described as osteomata of the antrum are of this nature.

II. Tumours of Epithelial Origin.

The various tumours grouped under this heading are composed mainly of epithelium, with a variable admixture of connective tissue. They are derived from pre-existing epithelial structures, and vary in the arrangement and character of the epithelium with the site of origin. Epithelial cells can practically be of only three types: (*a*) The spheroidal or cuboidal, in which the three diameters are more or less equal; (*b*) the flat or squamous, in which two diameters are long and one very short; and (*c*) the columnar, in which one diameter is long and two are short. These three forms of cells are found in most of the groups of epithelial tumours. In some the structure conforms more or less to the normal type, and then the growth is probably of an innocent nature, as in the papillomata and adenomata; but when the structure becomes atypical, the tumour is likely to be malignant and of a cancerous nature.

Papilloma.—This term ought really to be limited to tumours formed by an overgrowth of papillæ, and since papillæ are confined to regions covered with epithelium of epiblastic origin, they are, strictly speaking, only found in the skin and the so-called 'mucous membranes' which are morphologically of the same nature—*i.e.*, that lining the mouth, vagina, larynx, anus, etc. They consist of the same structures as a normal papilla, there being a central core of mesoblastic tissue (connective tissues, vessels, etc.) covered by squamous epithelium, which may or may not undergo excessive horny development, and, like the normal papillæ, of which they are an exaggeration, they project outwards from the general surface of the body, and never invade the subcutaneous or submucous tissues.

The term is, however, often used loosely to indicate a growth composed of a mesoblastic core with an investment of epithelium, whatever its origin; thus, we speak of papillomata of the large intestine, although in this region papillæ do not occur. Hence it becomes convenient to classify the papillomata according to the nature of the epithelium with which they are covered, since this is readily recognised microscopically, and affords a clue to their place of origin.

(1) Those covered by *squamous* epithelium occur in the skin, mouth, larynx, etc., and consist of bundles of papillæ, which undergo extensive proliferation and frequently branch, forming secondary papillæ. If the epithelium undergoes keratinization, as in the common warts, they become hard, and may constitute horn-like outgrowths. When they occur in moist situations, *e.g.*, between the toes, on the prepuce, or growing from mucous membranes (except that covering the vocal cords), this formation of horny substance is usually very imperfect, and the papillomata remain soft. It must be pointed out that many of the squamous papillomata are of infective origin, and not true tumours at all—*e.g.*, the venereal warts, condylomata, and mucous tubercles. There are

some reasons for thinking that warts may be infective and due to the action of a micro-organism. Not unfrequently a papilloma which has become irritated may take on malignant action and be transformed into an epithelioma, a change which would be characterized clinically by the base becoming infiltrated.

The papillomata which develop in the bladder and pelvis of the kidney are covered by many-layered *transitional* epithelium, and usually form long delicate fimbriated tufts containing delicate

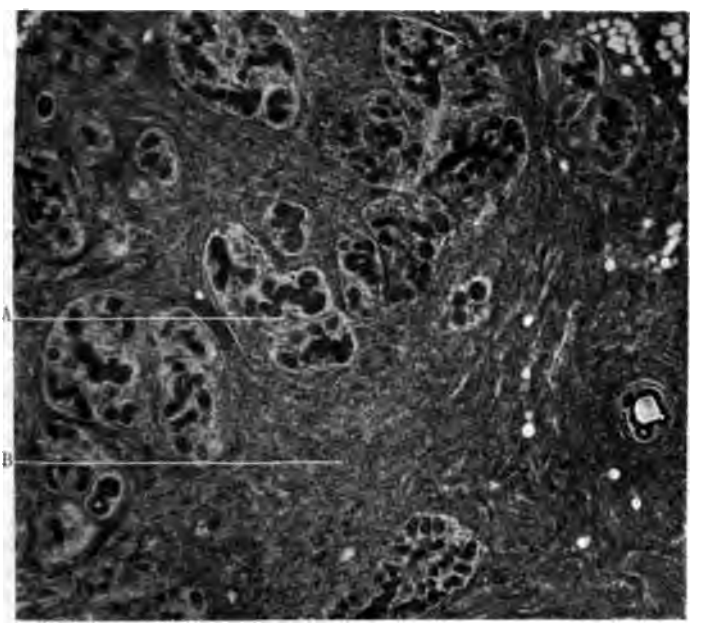


FIG. 47. FIBRO-ADENOMA OF BREAST. (PHOTOMICROGRAPH.)
A, Newly formed glandular tissue; B, fibrous stroma.

bloodvessels, which readily give way and may lead to considerable hæmorrhage. Portions are often torn off and escape in the urine, where they are easily recognised. They often occur in conjunction with malignant growths.

(2) Papillomata covered by *cuboidal* or *spheroidal* epithelium occur in glandular structures, especially in cystic adenomata of the breast, kidney, etc.

(3) Papillomata covered by *columnar* epithelium are sometimes found projecting into cystic cavities in other tumours, as in the proliferous ovarian cysts and in duct carcinoma of the breast, as also into dilatations of other ducts. The 'papillomata' of the intestine are usually either adenomata or fibromata.

Adenomata consist of new growths arising in connection with secreting glands, and in structure simulating somewhat closely the organs from which they rise (Fig. 47). They differ from them, however, in that they are incapable of producing the characteristic secretion, that they are devoid of ducts, and that the mimicry is incomplete, since the alveoli are less perfectly developed, and may be entirely occupied by several layers of epithelial cells. The epithelium, which from the nature of the case is spheroidal, cuboidal, or columnar in shape, does not pass beyond the basement membrane into the connective tissue, and by this lack of infiltration they are distinguished from cancerous tumours. A variable amount of connective tissue is always present, and may be normal in texture, or may manifest various modifications. Adenomata are usually encapsuled, being merely connected with the original gland by a pedicle, through which the vessels enter. When growing from mucous membranes, they are sometimes pedunculated, as in the so-called polypus recti. The alveoli in some cases become distended with effusion, giving rise to a cysto-adenoma or adenocele. They are absolutely free from malignancy, except when, as occasionally happens, the connective tissue undergoes a sarcomatous change, whilst sometimes carcinoma supervenes. When of large size, they may cause trouble by compression of important structures. Any glandular organ may become affected with adenoma, and several varieties will be described hereafter in the chapters on the breast, thyroid body, prostate, testis, etc. They are also found as congenital tumours in connection with the thyroid body, postanal gut, and possibly the kidney. The growth is usually slow, but occasionally becomes rapid.

Carcinoma.—The **malignant forms** of epithelial new growth are known as cancers or carcinomata, of which the following varieties are described, viz., epithelioma, columnar carcinoma, and glandular or acinous cancer, according to whether the epithelium from which the tumour is derived is of the squamous, columnar, or spheroidal type. The term 'colloid cancer' is also used to indicate a degenerative change occurring in some forms.

The essential character of a cancerous growth consists in an unlimited multiplication of the epithelial elements of the organ or tissue attacked. In some cases this may result in the formation of a superficial outgrowth of a papillomatous type, while deep processes or columns of cells advance into the tissues along the lymphatic channels, and even burst through the basement membrane of glandular alveoli. The irritation of this development leads to an infiltration of the surrounding structures with round cells, which are presumably inflammatory in origin, by the agency of which the normal tissues are disintegrated and removed, and a stroma of variable density develops around the epithelial outgrowths. Hence all cancerous tumours may be said to consist of a fibro-cellular or fibro-cicatricial stroma (Fig. 51), within the alveoli of which are collections of epithelial cells, sometimes arranged in a

closely resembling a rodent ulcer. (*c*) Occasionally the superficial outgrowth is excessive, and the destructive process limited, giving rise to a projecting cauliflower-like mass, which is soft and easily bleeds (*malignant papilloma*). (*d*) A chronic epithelioma is sometimes seen, in which the fibrous stroma contracts and compresses the

FIG. 49.—EPITHELIOMA OF LIP.

The epithelium at the left-hand margin of the figure is normal, whilst at A the altered appearance of the cells appears to indicate that they have become malignant; at B, C, D, they are growing down into the stroma in irregular columns; B indicates a small cell-nest, and C passes through one half an inch from its extremity. The connective-tissue stroma is inflamed. This is most marked at F.

columns of epithelial cells; the surface is then indurated and wart-like, with but little ulceration, whilst the base is very hard, and the progress of the case much less rapid than in other forms. This form is not uncommon in the lip (Fig. 295).

polygonal in shape, and in the outer layers may become flattened and undergo imperfect keratinization. This is best seen in the cell nests (Fig. 50) which develop in the substance of the columns, and in these the different layers can be readily traced.

Glandular or Acinous Cancer.—Glandular cancer may be looked on as a *malignant* form of *adenoma*, bearing the same relation to the latter as does an epithelioma to a benign papilloma. The epithelium of the glandular acini, from which it originates, is not retained by

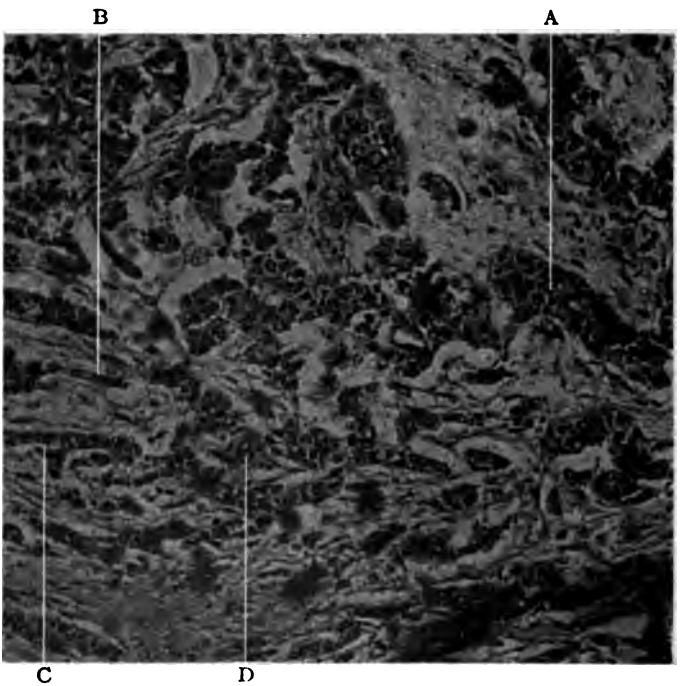


FIG. 51.—CARCINOMA (SCIRRHUS MAMMÆ).

A is an alveolus of epithelial cells; B, a column of similar cells infiltrating the connective tissue. C is also a fine column of growth which has shrunk away from the stroma, so that the endothelial lining of the space is apparent; the presence of this endothelium shows that the space now filled by cancer cells was originally a lymphatic vessel or space. D is a large epithelial cell with a single nucleus (parenchymatous giant cell).

the basement membrane, but travels beyond it along the lymphatics into surrounding parts, which are transformed into the tumour substance by a process already described. The amount of stroma varies considerably, and according to whether it is abundant or small in quantity, the tumour is hard or soft in consistence, and slow or rapid in growth. To the former type the term **Scirrhus** is applied; to the latter, **Encephaloid**.

Scirrhus is met with most frequently in the breast, but also occurs in the prostate, pancreas, and pyloric end of the stomach. The clinical features of the disease as seen in the breast are described in Chapter XXXIII. On naked-eye examination a scirrhous tumour appears as a hard nodular mass, the limits of which are imperfectly defined. When cut across, it creaks under the knife, and presents a yellowish-white surface, which rapidly becomes concave owing to the contraction of the fibrous stroma. It has often been compared to the section of an unripe pear or turnip, both on account of the grating sensation imparted to the knife and from its appearance. On scraping the cut surface with the blade of a knife, a typical cancer juice is obtained, consisting of epithelial cells and débris.

On microscopical examination, the tumour is found to consist of an abundant and well-marked stroma, the acini of which are filled with epithelial cells (Fig. 51). In the centre fatty degeneration is often present, small cysts being occasionally produced in this way. At the periphery the growth may be seen extending in all directions along the lymphatics, whilst a round-celled infiltration of the surrounding tissues is also evident.

Where the stroma is very excessive, the cell elements, and, indeed, the whole tumour, may undergo atrophy, owing to compression of the nutrient vessels, constituting the variety known as *atrophic scirrhus*.

Encephaloid, Medullary, or **Acute Cancer**, is the term given to a growth of a similar nature, in which the stroma is much less abundant than the cell elements. It constitutes a rapidly-growing tumour, not so hard as a scirrhus, abundantly supplied with bloodvessels, and very early infiltrating surrounding parts and affecting neighbouring lymphatic glands. The skin over such a tumour is stretched, and dilated blue veins can be seen through it. Ulceration occurs early, and from this surface a foul, bleeding, fungating mass sprouts up formerly known as a 'fungus hæmatodes.' Encephaloid cancer is met with in the breast, testis, kidney, and a few other glandular organs.

On section it is found to be composed of a soft whitish mass, somewhat resembling brain substance. It is usually very vascular, perhaps pulsating, and hæmorrhagic extravasation into its tissues is not uncommon. An abundant juice is obtained on scraping. Under the microscope large groups of spheroidal epithelial cells are seen, held together by a scanty stroma.

Columnar Carcinoma.—This affection, which was formerly termed 'columnar epithelioma,' is in the majority of cases a true glandular cancer. It is met with most frequently in the alimentary canal, arising from any portion of it in which columnar epithelium occurs, and usually originating as an overgrowth of Lieberkühn's follicles (Fig. 53). These form a projecting growth from the surface in the same way as a papilloma springs from the skin, but also penetrate deeply into the submucous and muscular coats. The deep processes retain an imperfect alveolar arrangement, and between them

is found a certain amount of fibro-cellular stroma, upon the charac of which the hardness of the tumour depends. In the firmer ty the stroma is abundant, and fibro-cicatricial in quality, the grow of the tumour being slow; in the softer and more rapidly-growi forms the stroma is less abundant, and more of a simple fibro-cellu nature. On section of a limited portion of the growth, it is usua possible to distinguish it from a simple adenoma of Lieberkühn follicles, since in the latter the alveoli are complete and regula lined with a layer of columnar epithelium, whilst in cancer the alve

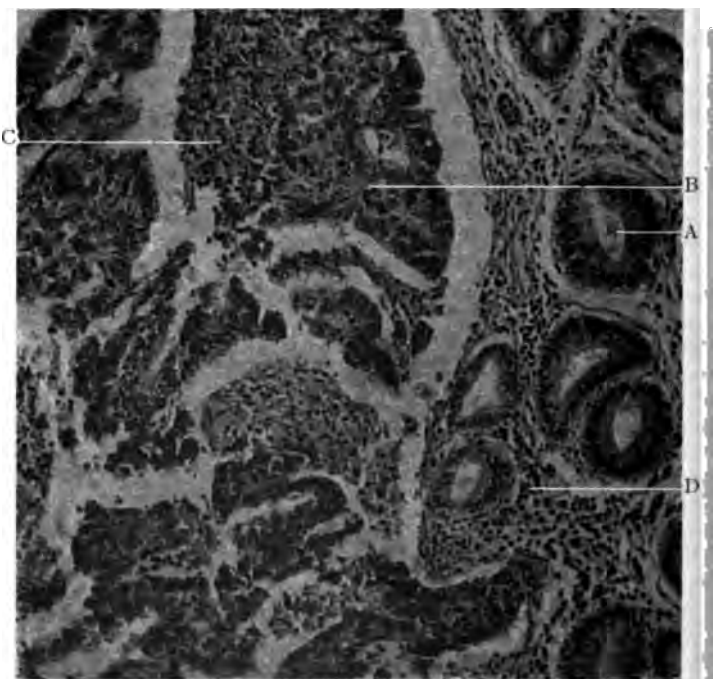


FIG. 52.—COLUMNAR-CELLED CARCINOMA OF RECTUM.

A is a normal gland, the regular construction of which is in marked contr to the irregular formation of the malignant gland, B. The latter conta mucus, broken-down cells, and leucocytes, C, whereas the normal gla are practically empty. D is a mass of small round cells in the stroma.

vary in shape and the epithelial elements are much less regula arranged. The distinction is well seen in Fig. 52. If a large sectio including the whole thickness of the intestinal wall, is examine the extension of the glandular tissue into and between the muscul fasciculi (Fig. 53) at once indicates the malignant nature of the ca Ulceration usually occurs, giving rise to a typical sore, bounded

the more chronic forms by indurated and everted edges. Neighbouring lymphatics are implicated, as in the case of all cancers, whilst later on the disease spreads to the viscera, and may be generally disseminated. A similar type of growth occurs in the cervical portion of the uterus, and occasionally in the ducts of glands such as the liver and breast. It is also met with in the superior maxilla, originating in the tubular glands of the mucous membrane lining the antrum.

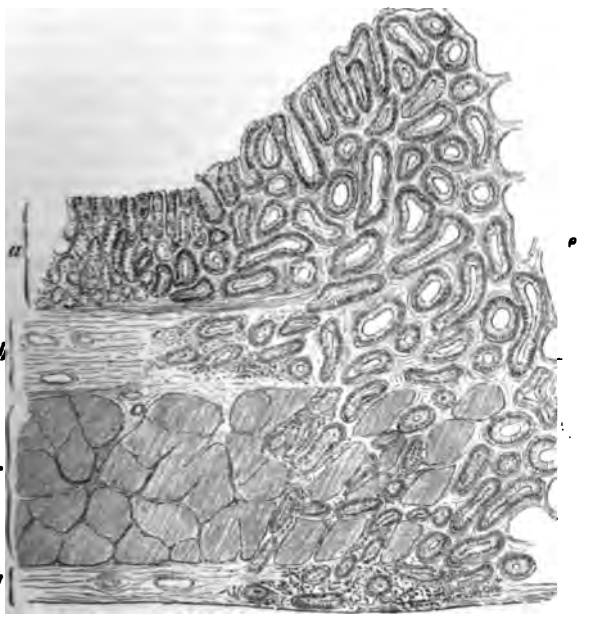


FIG. 53.—SECTION THROUGH ADVANCING MARGIN OF COLUMNAR CANCER OF STOMACH. × 25. (ZIEGLER.)

a Mucosa; *b*, submucosa; *c*, muscularis; *d*, serosa; *e*, neoplasm which, starting from the mucosa, has invaded the other layers. Small-celled infiltration has accompanied here and there the formation of the neoplastic tubules.

Colloid Cancer results from a degeneration of the epithelial cells of a glandular or columnar cancer. Its most frequent site is within the abdominal cavity, in connection with cancers arising from the stomach, intestine, or omentum.

To the naked eye colloid cancer presents an alveolar texture, the cavities being filled with translucent gelatinous material of varying density. Microscopically, the epithelial cells are rarely distinguishable, being replaced by a structureless colloid substance. Towards the growing margin, however, the cells may be seen in process of degeneration, globules of the material forming within them and pressing the nucleus to one side.

The **Treatment of Cancer** consists in the removal of the tumour by operation, together with a wide margin of healthy tissue around it, or, in some cases, of the whole organ affected, as well as the lymphatic area concerned, and, if practicable, in one mass, so as not to cut across the lymphatic vessels passing from the growth to the glands. If such is conducted in a thorough manner and at a sufficiently early date, a good result may be anticipated; but, owing to the tendency of all cancers to spread along lymphatics, its eradication is usually a matter of the greatest difficulty. Recurrence is therefore very liable to ensue.

In cases where removal of the disease by the knife is impracticable, owing to its extent, it may sometimes be possible to remove a portion of the disease, the remainder being dealt with by caustics. Of these the most satisfactory is chloride of zinc, which is usually applied as a paste, a little opium being added to allay pain. In other instances it has been proposed to starve the growth by tying the chief nutrient artery, and to diminish pain by division of sensory nerves; such can, however, only give the most temporary relief.

Of recent years other methods have been suggested for the treatment of inoperable malignant disease, *e.g.*, the interstitial injection of pyoktanin or methyl violet, or of various bacterial products, such as Coley's fluid (p. 185). The evidence at present forthcoming suggests that the practical value of these proceedings is very small.

Somewhat more hopeful results have been obtained by the use of the X rays. The effect of exposure to this agent is to set up a localized leucocytosis, and this results in the breaking down of the neoplastic tissue and its replacement in favourable cases by fibrous tissue. The whole subject is still in the experimental stage, but our present experience seems to indicate that early recurrences in the skin of the cuirasse type, ulcerating and fungating masses, and some forms of sarcoma, benefit most from this procedure. In the case of epitheliomata the results have been most discouraging, whilst deep-seated foci of disease are practically uninfluenced.

The application of the rays should always be in the hands of skilled radiographers, as serious and extremely chronic burns may result from injudiciously prolonged sittings, and the mischief done may not become evident until twelve or fourteen days after the particular application. Surrounding parts must be carefully guarded by lead-foil or by the use of a 'shielded' tube which only allows the rays to act on the required area. Modern improvements in the direction of accurately measuring the quantity and quality of the rays will certainly allow this method of treatment to be used more scientifically.

High-frequency currents have been extensively used in this direction, but *per se* have no influence on the disease, although they may improve the general health by their tonic effect. The recently introduced 'high vacuum electrodes' give off a small quantity of X rays, and may enable one to apply these rays to cavities or in situations which would be otherwise inaccessible.

In hopeless cases all that can be done is to keep any ulcerated surface free from irritation and, if possible, aseptic, whilst the general

health is maintained by suitable diet and drugs, and pain is kept in check by morphia or opium.

Rodent Ulcer is a special variety of glandular cancer, commencing either in the sebaceous glands or in the basal layer of the rete Malpighii. It is usually met with in elderly patients, though occasionally observed in those under forty, and is seen with special frequency on the upper two-thirds of the face, the skin below the inner and outer canthi being the chief seats of election. It commences as a papule or flat-topped nodule in the skin, surrounded, perhaps, by an area of hyperæmia. The infiltration extends gradually in all directions, but the ulceration usually keeps pace with the new growth. The ulcer has a smooth but somewhat depressed surface, is perhaps covered with granulations, and bounded by a slightly-raised, indurated, rolled over edge (Fig. 54). In the later stages one can often detect evidences of the new formation beneath the skin beyond the edge. If kept aseptic, there is but little discharge, and imperfect attempts at cicatrization are often observed, the scar, however, readily breaking down; but when septic, the surface is covered with sloughs, and an abundant offensive discharge escapes. The condition is painless; neighbouring lymphatics are not enlarged, and the general health does not suffer, except in the later stages. The progress of the case is slow, but continuous, and although it spreads superficially rather than deeply, sooner or later underlying structures become involved, and in spite of it undermines the destructive process, even the bones of the skull become eroded, and the dura mater exposed.

FIG. 54.—RODENT ULCER. FROM A PHOTOGRAPH.

Microscopically, the growth is very similar to an epithelioma, consisting of interlacing columns of epithelial cells, interspersed

with fibro-cellular tissue (Fig. 55). The chief differences consist in the facts—(i.) that the constituent cells, although epithelial, are not epidermic in character, being smaller, more globular, never of the 'prickle-cell' type, and rarely showing signs of keratinization; hence, 'cell-nests' are uncommon, although they are sometimes observed. (ii.) The deep processes are not so distinctly columnar or club-shaped, spreading laterally beneath the unaffected skin

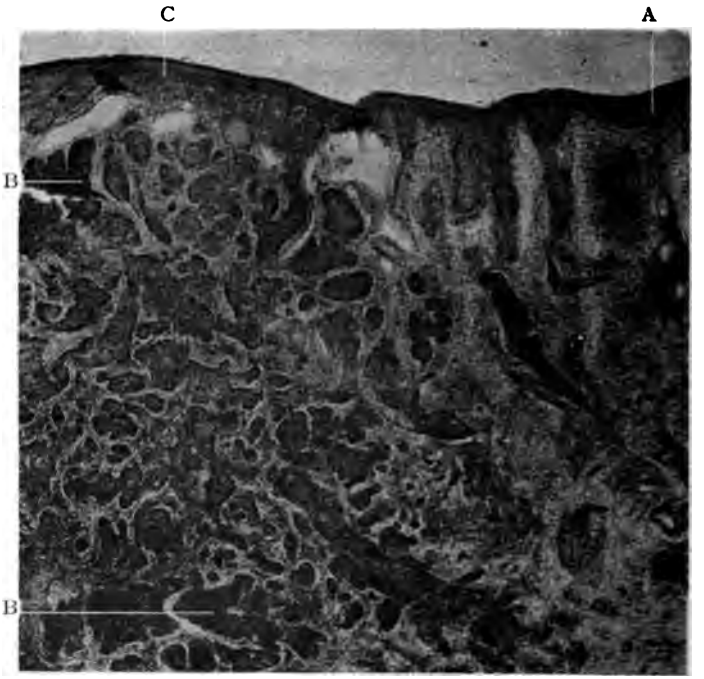


FIG. 55.—RODENT ULCER OF EYELID.

A, Normal epithelium; B, alveoli of growth. At C the skin is thinned out by the pressure of the underlying growth, from which it is quite distinct.

rather than deeply; their outline is also more clearly defined, and frequently angular on section. (iii.) There is less cell infiltration around the new formation.

The **Treatment** of rodent ulcer has been considerably modified of late. Formerly the method of choice consisted in free excision when practicable, a margin of *at least* half an inch being allowed all round, and the defect made good by skin-grafting or by some plastic operation. Where such could not be undertaken, the ulcer was thoroughly scraped, and the surface treated with nitric acid, chloride of zinc paste, or some other caustic, the wound being allowed to heal by granulation.

stroma between these columns is profoundly altered, usually b coming mucoid or converted into a hyaline tissue resemblin cartilage; fat is often deposited in it, and cystic degeneration ma take place, the tumour thus formed being of extraordinary complexit In other cases the cells affected are those lining the smaller lymphat vessels, and in some cases this may especially involve those occurrin in the vascular sheaths, forming a cellular investment to the small

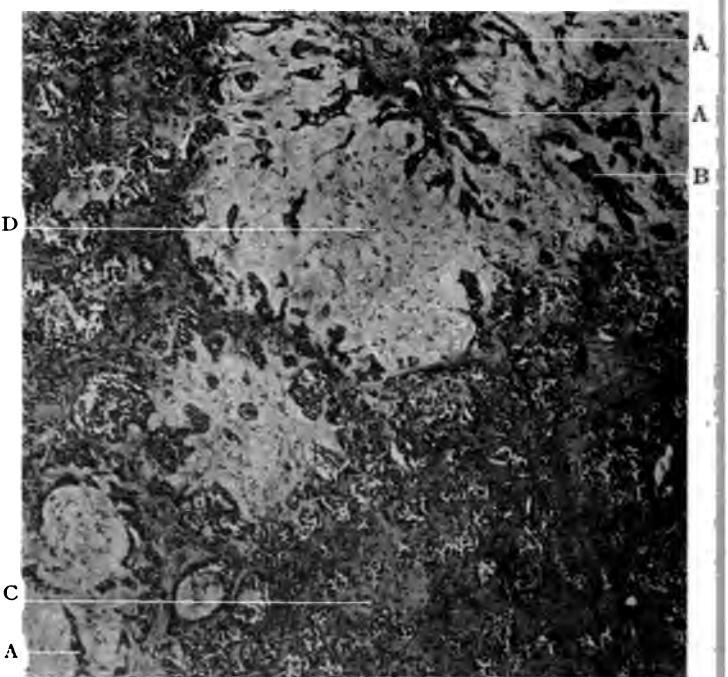


FIG. 56.—ENDOTHELIOMA OF THE PAROTID GLAND

A, Strands of endothelial cells lying in lymphatic clefts, and forming a kind natural injection of those structures; B is a similar strand, but the cel have continued to grow, and the strand is many cells thick. At C there a alveoli of endothelial cells less closely packed; D is the cartilage-like stron common in these tumours.

vessels (perithelioma or perithelial sarcoma). In a third group t endothelium which takes on morbid growth is that which lines t bloodvessels themselves. In this case it is common for the cylinde of cells thus formed to undergo a hyaline degeneration (cylindroma

The endotheliomata which occur in the brain are usually compos of spindle-shaped cells, which have a tendency to organize in fibrous tissue, and have a curious arrangement in whorls, somethi like those of a cell-nest. The central portions of these mass

frequently undergo conversion into a material resembling amyloid substance, and subsequently become calcified. These tumours are called **Psammomata**. They are amongst the commonest new growths met with in the brain, and are usually superficial, are readily shelled out, and do not tend to recur after operation.

IV. Tumours formed by Inclusion of Part of another Embryo.

Teratomata are tumours derived from included embryos, or from portions of a second embryo, which are formed by dichotomy, but which have remained rudimentary and partially or completely buried in the tissues of the host. The commonest example is the so-called *dermoid of the ovary*, which is sometimes a complex tumour, and differs from the simple dermoid cysts (formed by inclusion of a piece of skin shut off from the surface in the process of development) in that it contains structures such as bone, muscle, gland tissue, etc., which are formed from all three layers of the embryo. In some rare cases the tumour is more complex still, larger portions of an embryo (such as a limb) being recognisable. Similar dermoids are found in the testis and in other portions of the body, though only in rare cases. Teratomata of complex structure are often found in the sacral region, where they are probably due to posterior dichotomy, the smaller portion of the embryo remaining rudimentary and attached to the larger twin in the region of the sacrum.

Cysts.

By a **cyst** is usually meant a more or less rounded cavity, with a distinct lining membrane, distended with some fluid or semi-solid material. The term is used very loosely, being applied to a variety of manifestations which it is difficult to classify, owing to the fact that conditions which are pathologically similar in origin are sometimes termed cysts in one part of the body, and not so in another. For practical purposes, however, they may be grouped as follows:

I. Cysts of *embryonic origin*, or arising in connection with embryonic remains.

II. Cysts arising from the *distension of pre-existing spaces* (distension cysts).

III. Cysts of *new formation*.

IV. Cysts of *degeneration*.

I. Cysts of Embryonic Origin, or arising in Connection with Embryonic Remains.

1. The most important cysts to be considered under this heading are those known as **Dermoids**. These are characterized by the existence in abnormal situations of cavities lined with epithelium, from which may be developed such forms of cutaneous appendages as hairs and nails, whilst the space is usually occupied by sebaceous

contents. The structure of the lining wall is very similar in m to skin or mucous membrane, consisting of stratified epithelium, which a considerable growth of sebaceous glands and hair fol often takes place. If teeth or more complex tissues, such as alveoli, mammary glands, nipples, etc., are enclosed in such a cy it should probably be looked on as a teratoma.

Several varieties of dermoids are described:

(*a*) **Sequestration Dermoids** are cysts arising from the incom disappearance of surface epithelium in situations where, d embryonic life, fleshy segm coalesce. Thus, in almost part of the middle line of body such tumours may dev owing to the fact that the here a union of two la segments. Similarly, they not uncommon about the and neck, occurring along lines of the facial and bran clefts. Perhaps the most com position for them in this reg the upper portion of the o nasal cleft, behind and to outer side of the eye (Fig. It is not unusual to find skull defective beneath t and a pedicle extending fro deep side, connecting with the dura mater. Sequ tion dermoids appear as rou definitely limited tumours, which the skin glides freely are usually somewhat adh to the deeper parts. They are firm and elastic to the touch filled with sebaceous material, containing fatty débris, flat epithelial cells, perhaps hairs, and occasionally teeth. This of dermoid may be removed without difficulty, but in those occu about the scalp, with the bone hollowed out beneath them, perhaps advisable to delay operation till adult life, unless the tum are rapidly increasing in size. The reason for this is that the gradually grows up around the pedicle, and thus closes the comm cation with the cranial cavity. In some cases it may be diffic remove the whole of the lining membrane by dissection, and i these circumstances the portion left behind should be destroyed cautery or caustics: otherwise, recurrence is almost certain to fo

FIG. 57.—DERMOID CYST, GROWING AT THE OUTER ANGLE OF THE ORBIT. (BLAND SUTTON.)

(*b*) Dermoids may also arise in connection with embryonic c and passages, and have then been called **Tubulo-Dermoids.** T are chiefly met with in connection with the thyro-glossal (Chapter XXXI.) and the post-anal gut (Chapter XXIV.).

c. **Ovarian Dermoids** are usually unilocular, and often of large size. They are lined with skin, from which an abundant development of cutaneous appendages is sometimes observed. Thus, the cavity may be more or less filled with hair, whilst large masses of teeth set in bony alveoli are also seen in this situation, and even nipples and mammæ. We have already explained that probably all of these growths are to be looked on as teratomata.

2. **Cysts** occasionally arise *in connection with* the formation of *the teeth*; such have been already alluded to under the terms follicular and epithelial odontomes (p. 199), the former being also known as dentigerous cysts, the latter as fibro-cystic disease of the jaw.

3. Various cysts develop in connection with *the remains of the Wolffian body*, as also from *its tubules and duct*. It must be remem-

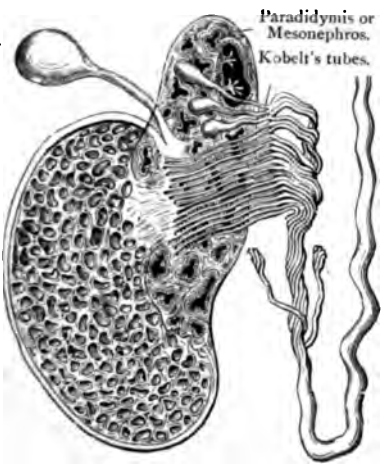


FIG. 58.—DIAGRAM OF ADULT TESTICLE, TO SHOW RELATION OF MESONEPHROS AND ITS DUCTS. (BLAND SUTTON.)

bered that this body arises in the posterior abdominal wall near to the origin of the kidney and testis, and that part of it enters into the formation of the latter; hence one is not surprised to find that its remains are closely associated with that organ in the scrotum.

In the **male** (Fig. 58) the Wolffian body atrophies almost completely, being represented by a few blind tubules, situated close to the epididymis, and known as the paradidymis, or organ of Giraldès. Fibro-cystic disease of the testis (adenoma testis) is said to arise from this structure. The majority of the ducts of the Wolffian body form the vasa efferentia testis; a few of the upper ones, however, contract no attachment to the gland, and their free ends (known as Kobelt's tubes) may become dilated, and form small cysts, situated close to the hydatid of Morgagni, which structure represents the remains of the Müllerian body and duct. It is

possible that an encysted hydrocele of the epididymis sometimes arises from one of these unobliterated tubules. The main duct of the Wolffian body forms the lower portions of the epididymis and vas deferens.

In the **female** (Fig. 59) the remains of the Wolffian body are sometimes met with as a series of closed tubes in the neighbourhood of the ovary (paroöphoron). Cysts may arise in connection with this structure, and are chiefly characterized by their inner walls being the seat of proliferating papillomata. The Wolffian tubules can almost always be recognised in the broad ligament, constituting the parovarium, or organ of Rosenmüller. **Parovarian Cysts** formed from the distension of this structure are usually unilocular, and filled with a clear limpid serous fluid; they have no definite pedicle, and strip up the layers of the broad ligament.

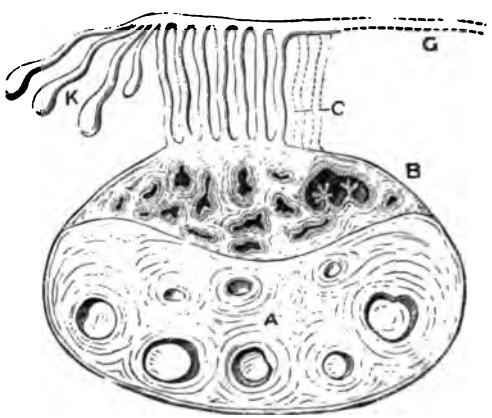


FIG. 59.—DIAGRAM TO REPRESENT THE CYST REGIONS OF THE OVARY. (BLAND SUTTON.)

A, Oöphoron, or ovarian tissue; B, paroöphoron, or tissue of the hilus; C, parovarium; K, Kobelt's tubes; G, Gärtner's duct (=main Wolffian duct).

Some of the terminal tubes may be converted into small cysts which project from the fimbriated ends of the Fallopian tube, and are known as cysts of Kobelt's tubes. The main Wolffian duct generally atrophies, but occasionally runs down between the layers of the broad ligament close to the uterus, to open in the vagina near the urethral orifice, being then known as Gärtner's duct. Cysts may occasionally arise in connection with this structure, projecting into the lateral fornix of the vagina.

4. The *processus vaginalis*, or funicular process, is the term applied to the protrusion of peritoneum which precedes the testis to form the tunica vaginalis, and which in the female accompanies the round ligament (*canal of Nuck*). Normally it becomes obliterated, but sometimes portions of it remain patent, and are distended with a

(*a*) An **Implantation Cyst** is one which arises from the accident intrusion into the subcutaneous or submucous tissues of epitheli cells which retain their vitality, and are enabled to develop a cy very similar in nature to a dermoid; in fact, it may be looked up as an *Acquired* or *Traumatic Dermoid*. Such an occurrence is usual brought about as the result of an injury, especially from punctur wounds; thus, cysts of this nature have been met with in t fingers or palm of the hand as a consequence of the penetration some sharp instrument, whilst they are also occasionally seen in t anterior chamber of the eye, following an iridectomy. They ar moreover, observed in the axillæ of cattle, as result of goading them with a sharp impleme The clinical signs and treatment are similar those of a dermoid cyst.

FIG. 60.—TÆNIA ECHINOCOCCUS. × ABOUT 20.

(*b*) **Cysts** may form **around foreign bodies**, whic thus become encapsuled. They are lined wit granulation tissue or endothelium, surrounded b a variable amount of fibro-cicatricial tissue.

(*c*) **Blood Cysts** are sometimes of doubtful origin Some certainly arise from extravasation of blood and are then filled with coagulated blood, or a thi serous fluid with a varying amount of laminate fibrin. In many cases a so-called blood cyst really a soft sarcoma, into which hæmorrhage h occurred; but a few instances are on record which a thin-walled cavity existed, occupied blood, and readily refilling after it had been tapp and with no evidence of any growth. Such c ditions have been most frequently observed in neck (see Chapter XXXI.).

(*d*) **Parasitic Cysts** are produced by the irritat caused by the growth within the tissues of cer living organisms. Thus, in the disease known trichinosis, derived from eating unsound pork, *Trichina spiralis*, a small round worm, develops large numbers in the voluntary muscles, a becomes surrounded by a capsule which is su sequently calcified.

The most important of these parasitic cysts that caused by the development within the body the scolex stage of the *Tænia echinococcus*, givi rise to what are known as **Hydatid Cysts.** Th disease is much more common in Australia than this country. The *Tænia echinococcus* (Fig. 60) is minute tapeworm, less than half an inch in length, which inhabi the intestinal canal of dogs; it consists of four segments, t posterior one being larger than the rest of the body, and co taining the genital organs. When mature, this last segme becomes filled with ova, which are discharged, and these find th

y into the human stomach by the media of water or uncooked getables, such as watercress, which have been contaminated with e dog's excreta. The process of digestion sets the embryo free,

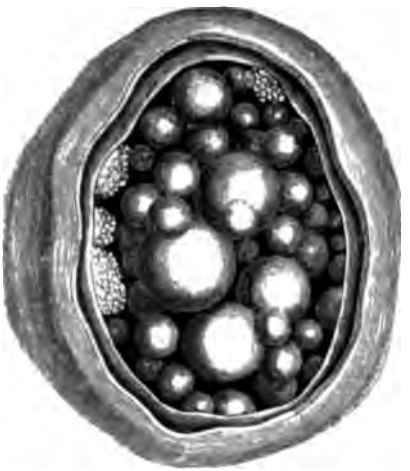


Fig. 61. Hydatid Cyst. Diagrammatic, showing Daughter-Cysts and Brood-Capsules growing from the Walls. (After Bland Sutton.)

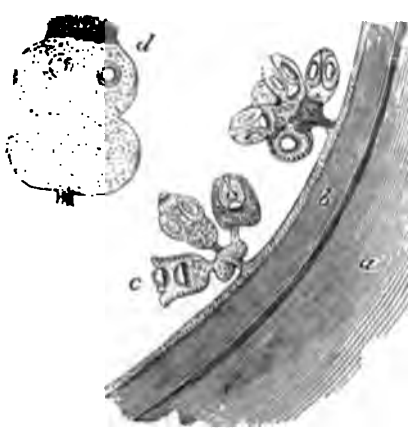


Fig. 62. Diagrammatic Section of Wall of Cyst.

a, fibro-cellular capsule, here somewhat exaggerated. *b*, lamellated chitinous layer, or ectocyst. *c*, brood-capsules developing from the protoplasmic layer, or endocyst. *d*, scolex, or separate head, enlarged.

l by means of a crown of little hooks which it possesses, as well as suckers, it is enabled to bore its way through the walls of the nach, and thence travels by the bloodvessels to the liver or some

other part of the body. As a result of the irritation caused by its presence, a sac forms, which originally consists of three layers; externally, a fibro-cicatricial layer, then an intermediate lamellated layer of chitinous material (true *ectocyst*), and finally the cyst is lined by a protoplasmic germinal layer (*endocyst*), from which may be developed solitary tænia heads or scolices, also provided with four suckers and a circlet of hooks, whilst sometimes groups of them, known as brood-capsules, may arise in the same way (Fig. 62). Daughter-cysts are not unfrequently formed from the scolices, and they in their turn may pass through the same changes, although as a rule they are barren. Occasionally even the main cyst may be sterile (*acephalocyst*), and in such cases the walls become very definitely laminated. The fluid contained in the cyst varies much in amount, but is always of low specific gravity, not more than 1007; it is colourless, but slightly opalescent, limpid, and contains but a trace of albumen, although a considerable amount of chloride of sodium is present. On examining the fluid microscopically, the characteristic hooklets are observed. The organs usually affected by hydatid disease are the liver, kidneys, and brain, but any part of the body may be attacked. Occasionally in the liver, and usually in bone, multiple cysts develop quite distinct from each other, and with no general cyst-wall (*exogenous* multiplication). This can only occur when the ectocyst is thin, allowing the scolices, which always have a retractile neck, to push through and 'swarm off' into surrounding tissues.

Hydatid cysts give rise to no special symptoms, except those caused by their size and situation, and they are likely to go on growing until operative treatment becomes imperative on account of some complication, or from the size of the mass. At any time the cyst may *rupture*, either spontaneously or as the result of some injury; if into a serous cavity, such as the peritoneal or pleural, this becomes infected, and an abundant development of scolices and cysts ensues, giving rise to considerable localized inflammatory reaction; moreover, the escape of the cyst fluid may cause serious toxæmia, or, at any rate, urticaria, owing to the presence therein of some toxic substance.

Occasionally the organism *dies spontaneously*, and then the cyst shrivels up, and the laminated walls and daughter-cysts form a firm leathery mass, perhaps infiltrated with lime salts and of the consistency of wet mortar; a thick fibro-cicatricial capsule encloses the whole. At other times *suppuration* takes place within the cyst, and an abscess results. If acute, it bursts either externally, or may open into some serous cavity or hollow viscus; in the last case, the cyst may evacuate itself, and a spontaneous cure result. Sometimes the abscess becomes chronic and encapsuled, and may then remain quiescent for years.

For the diagnosis and treatment of hydatid cyst of the *liver*, see Chapter XXXIV. In other regions, if the tumour cannot be removed by dissection, reliance must be placed on drainage, where the situation of the growth renders this practicable, or aspiration, since it is

usually found that removal of the fluid contents causes death of the organism, probably by altering the intracystic tension.

IV. **Cysts of Degeneration** arise in connection with tumours, especially those where the blood-supply is not very abundant. Thus, mucoid degeneration is not uncommon in fibromata, fibro-myomata, chondromata, and even in the harder forms of cancer. Occasionally cysts form in the sarcomata from this cause, but more frequently as a result of haemorrhage.

CHAPTER IX.

WOUNDS.

A WOUND has been defined as the forcible solution of continuity of any of the tissues of the body; but the term is more commonly limited to injuries of the soft parts, involving the skin or mucous membranes. Lesions in which the skin does not participate, and in which the deeper structures, such as bones, ligaments, etc., are not involved, are spoken of as contusions.

A **Contusion** is any subcutaneous wound or injury due to the agency of external violence, causing laceration of the cellular tissue, without necessarily involving such deeper structures as muscles, tendons, nerves, or bones. The signs are usually very obvious, viz., **pain, bruising,** or discoloration of the part, and **swelling.** These are readily explained by the injury inflicted on the subcutaneous tissues, which in the worst cases may be entirely disorganized and separated from the skin. The amount of bruising varies with the part injured and the severity of the lesion; thus, in the eyelids, scrotum, and vulva, where the tissues are lax, the ecchymosis will be very extensive and of a black colour; on the scalp there is, on the other hand, but little swelling, if the injury does not include bleeding beneath the aponeurosis of the occipito-frontalis. Again, the condition of the patient's general health influences the amount of blood effused; in a strong man in good training but little bruising is seen, whilst in those of a languid temperament and relaxed tissues a slight injury often produces a very conspicuous ecchymosis. Blebs and bullæ may form over the injured spot in bad cases. The changes that occur in a bruise are well known, the colour passing from a blackish-purple through various shades of brown and green to a yellow, which gradually fades and disappears; this is due to the disintegration of the red corpuscles, and staining of the tissues by the hæmoglobin thus set free, or by the products formed during its removal. When hæmorrhage has taken place into the deeper parts or under dense fasciæ, it is often some days before the bruise 'comes out,' and this may occur at some distant spot, *e.g.*, in the eyelids after a blow on the scalp, whilst after a fracture of the neck of the humerus the blood may travel along the muscular and fascial planes, and the bruise first appear about the elbow.

Open Wounds.

An open wound may be defined as a solution of continuity of an superficial part of the body, including skin or mucous membrane Various kinds of wounds are described, such as the incised, lacerated contused, punctured, poisoned, and gunshot; but, of course, th most important distinction to draw is between the infected and th non-infected.

I. **Incised Wounds.**—An incised wound is one made by any shar cutting instrument, but occasionally one not produced in thi manner may be characterized by similar appearances; *e.g.*, the ski of the knee or elbow may be cleanly split open from falling on with the limb flexed, and occasionally a policeman's truncheon wi lay open the scalp almost as evenly as if a knife had been employe

The special features of an incised wound are as follows:

1. The hæmorrhage is free, from the fact that the vessels a cleanly divided. The amount necessarily depends on the size the vessels involved, and the vascularity of the part; its contin ance upon the density of the structures allowing or not of co traction and retraction of the severed ends.

2. Separation of the lips of the wound also occurs, the amou depending upon the elasticity and character of the parts involved.

3. Bruising of the margins of the incision is absent, so that und ordinary circumstances rapid healing (by first intention) shou obtain. The surfaces, to begin with, are lined by a microscop layer of damaged tissue, some of which may be actually dead; b if suitable precautions are taken, this is absorbed, and in no w interferes with satisfactory union.

Treatment of Incised Wounds.—Seven essentials must be attend to if healing by first intention is to be obtained, viz.:

(i.) **The Arrest of all Bleeding.**—If there is general oozin exposure to the air is often quite sufficient; or sometimes it m be supplemented by pressure for a few minutes with an asep sponge. Arteries and veins will need a ligature, but if situat close to the skin, they may sometimes be secured by passing und the bleeding spot the needle used for the suture. The importan of complete hæmostasis in limiting or hindering bacterial develo ments has been already alluded to (p. 4).

(ii.) **Sterilization of the Wound and its Surroundings.**—This w be considered *in extenso* in Chapter X. In casualty work asep cannot be always assured, as the wound, though cleanly cut, made through dirty skin, and portions of clothing, dirt, a splinters of wood or glass may be carried in. Under these circu stances the wound and its surroundings must be thoroughly purifi according to the rules given on p. 267, and a free use of 1 in carbolic lotion, or even of Lister's 'strong mixture' (5 per cent. carbolic acid with 0·2 per cent. of corrosive sublimate), is advisab whilst foreign bodies are removed.

iii.) **The coaptation of the opposed surfaces** by means of **sutures** may now be undertaken. Many substances are employed for this purpose, but amongst the best are fine silver wire, silk, horsehair, silkworm gut and catgut. In casualty work, and for parts of the body where but little scar is subsequently desirable, as in the face, horsehair and silkworm gut, being non-absorbent, are perhaps the best materials to employ; but in ordinary operative work, which will be more certainly aseptic, and where the after-treatment is more efficient, fine catgut or silk may be used. There are three chief varieties of sutures, viz., the buried, the deep, and the superficial.

buried sutures are now largely employed, since a foreign body may be safely inserted into the tissues, if both it and the wound are aseptic. Some discrimination must be employed in the selection of the material chosen for a buried stitch, according to whether or not it is desirable that it should persist or be absorbed. If a part is not very strong and the cicatrix is exposed to a certain amount of tension, as in the abdominal wall after a laparotomy, non-absorbent material such as silk or silkworm-gut may be employed, and the incorporation of the suture in the cicatrix will prove a source of strength. At the same time it must be remembered that, if drawn too tight, the tissues within its grasp may be strangled, and suppuration at a later date determined even apart from external infection. In other cases all that is required of a buried stitch is to hold certain tissues in contact until a natural bond of union has developed, and then the sooner the stitch disappears the better—*e.g.*, in building up the tissues of the neck after the removal of a goitre or in re-uniting a divided nerve; for such a purpose fine non-chromicized catgut answers admirably.

Deep stitches, or *sutures of relaxation*, are required in cases where there is difficulty in bringing the edges of the wound together, in order to transfer the tension from the healing margin to tissues further away, the edges being thereby relaxed. For this purpose thick silver wire may be employed, inserted 1 or 1½ inches from the margins, and tied directly, or lead buttons may be interposed next to the skin, and the ends of the wire fastened round the projecting edges, thus diffusing the pressure over a greater space. They are generally removed at the end of two or three days.

Superficial stitches, or *sutures of coaptation*, must be so inserted as to bring the edges of the wound into contact without undue pressure, and without any folding in of the skin. Various methods are employed, viz.: 1. The *interrupted suture* (Fig. 63, A), in which each stitch is separately finished off, the knot lying well to one side of the incision. This is generally utilized for wounds which are of irregular shape or in which there is tension. 2. The *glover's stitch* (Fig. 63, B) is a continuous one, in which the thread is carried on from point to point, and only fastened at the ends; it is not to be recommended. 3. The *blanket* or *buttonhole stitch* (Fig. 63, C) is the form of continuous suture which should be employed for extensive wounds or incisions. In it the needle, after traversing the lips of

the wound, is carried under the slack of the thread, so that the l
of each stitch, as it is tightened, is maintained at right angles to
edge of the wound, whilst the intermediate portion lies parallel to
To fasten it off, the needle is passed in the opposite direction thro
the edges of the incision, with the free end long enough to prev
it coming through, and so enable it to be tied to the double por
carried through by the needle. 4. Halsted's *intradermic* or *su*
cuticular stitch (Fig. 63, D) may be employed when very exact
aptation of the margins is desirable, and a minimum of visible sc
required for cosmetic purposes, as in the face or neck. Fine si

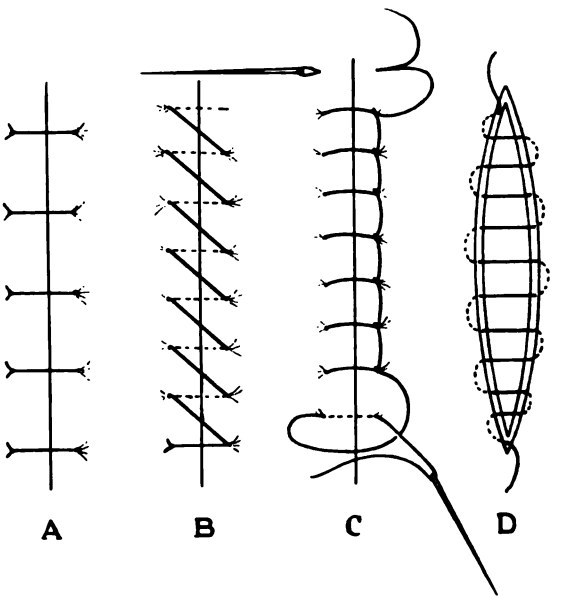


FIG. 63.—VARIOUS FORMS OF SUTURE.

A, interrupted suture; B, continuous suture; C, blanket stitch. At the lower end the needle has just been passed, and the way in which it catches up the loop is indicated. At the upper end the method of finishing off (originally suggested by the late Mr. Maunsell) is shown: viz., the needle is passed in the opposite direction to all the other stitches, the free end being left long, so as to enable it to be tied into a knot with the double thread which the needle has carried through; D, Halsted's intradermic or subcuticular stitch.

worm-gut or silver wire is employed, and a short straight needle. The needle is introduced in the substance of the skin beneath the cuticle and passed parallel with the surface, to emerge on the same level about a centimetre from the point of introduction, thereby taking up a semicircle of tissue; it is then introduced in a similar way on the opposite side of the incision, and the process is repeated from one end of the wound to the other. The suture is finally

arrest of the bleeding, causing separation of the lips or deeper portions of the wound; (ii.) the presence of impure foreign bodies or other septic material; (iii.) the edges not being brought into contact; (iv.) imperfect drainage, leading to tension on the stitches; (v.) infection of the wound from various causes; (vi.) lack of rest to the part; and (vii.) constitutional conditions, such as deficient general vitality from disease or other causes.

When blood collects in the deeper parts of the wound, the skin incision may heal satisfactorily, but there may be some local tenderness and a little swelling, and some slight fever, the temperature running up at night to about 100°. In such cases it usually suffices to open partially the incision, squeeze or press out the fluid, and insert a small tube or gauze drain. (For sepsis of wounds, see p. 76).

II. **Lacerated or Contused Wounds.**—Such injuries are caused by blunt instruments, by machinery, missiles, the wheels of a vehicle, etc. They are characterized by the following signs:

1. The **Hæmorrhage** is, as a rule. but slight, since the vessels are torn across irregularly, and not cut cleanly; the middle and inner coats, which give way first, are curled up within the contorted outer coat, forming a barrier sufficient to prevent loss of blood. The vessels, being elastic, may be pulled out of their sheaths, and are sometimes seen pulsating upon the surface.

2. The **Lips** gape less than in an incised wound, and are irregular, torn, and bruised. More or less extensive portions of dead tissue have to be disposed of before repair can take place, and hence this form of wound usually heals by granulation. When a limb is torn completely off, the tendons are often left long, and the muscular bellies project from their fascial sheaths as flabby congested masses, since the skin gives way at a higher point than the subjacent structures.

The **Progress** of the case depends largely upon the question whether the wound is or is not aseptic.

In an **Aseptic** lacerated wound it may be possible to bring the edges together by suture or otherwise, and, even though they are a little bruised, healing by a slightly delayed first intention is possible, if drainage is provided. If the wound remains open, the dead tissue is absorbed or separated, and an aseptic granulating surface results. There may be some simple traumatic fever for a day or two, but it is of little consequence.

If the wound is **Septic**, however, inflammatory phenomena supervene, resulting finally in a granulating surface. Three stages may be described in the course of the case, viz.:

(*a*) The stage of injury, resulting in shock.
(*b*) The stage of inflammation and sloughing, associated with septic traumatic fever.
(*c*) The stage of repair by granulation, or prolonged suppuration, with exhaustion and hectic fever in the worst cases.

The inflammatory period lasts a week, ten days, or more, according to circumstances, and during this period the patient is liable to

servative measures. (*b*) The vitality of the **extremity** injured. leg has to be sacrificed more frequently than an arm, since th vitality and reparative power of the latter are so much greate (*c*) The **septicity** or not of the wound is of the greatest significanc since, if infection can be prevented, the chances of preserving th limb are greatly improved, and one would then often delay operatio whereas sepsis would turn the scale in favour of radical inte ference.

The local conditions which suggest or determine the performan of an amputation may be conveniently divided into two group viz., where amputation is essential, or where it is doubtful.

A. **Amputation** is certainly **called for**—

1. To trim up the stump of a limb torn off by machinery, or c off by a railway train, or carried away by a cannon-ball.

2. When the whole limb or one complete segment of it has bee totally disorganized, or crushed to pulp, though still retaining i connection with the body.

3. In cases where gangrene is imminent or has supervene especially if it is of the spreading type.

4. When severe septic symptoms develop in a case where a attempt is being made to save a limb, the retention of which wa from the first doubtful; or when exhaustion supervenes from pro longed suppuration.

5. In severe compound lacerations of the foot *in old people*, invol ing the bones and laying open the common synovial cavity. Sept arthritis and necrosis are then very apt to ensue, whilst the distan of the foot from the centre of the circulation increases the likelihoo of gangrene.

B. **Amputation** is **doubtful** in the following conditions:

1. Compound comminuted fractures in parts other than the fo do not *per se* require amputation, even if neighbouring joints a implicated. By careful attention to antisepsis, free drainage, an the removal of detached fragments of bone and foreign bodies, whi should usually be accomplished under an anæsthetic, limbs formerl condemned to amputation can not only be preserved, but also restore to a considerable degree of functional usefulness. The final decisi will mainly depend on the age, condition, and previous habits of th individual.

2. When the soft parts have borne the brunt of the injury, an have been extensively stripped from the bones, amputation is by n means an essential, provided that they can be restored to the original position, that there is a reasonable probability of the vitality being maintained, and that the utility of the limb will not b hopelessly impaired, as a result of lesions to the nerves, after th wound has healed. The surgeon has here to balance carefully th risk run if an attempt is made to save the limb, and the value the the limb if saved will subsequently be to the patient. For instanc when the muscles of the forearm have been extensively torn i in a machine accident, it is a question whether it is worth wh

way into the pelvis of the kidney, and constitutes the nucleus of a renal calculus.

One of the most troublesome and painful forms of penetrating wound is that caused by a **fish-hook**, since the barbed end catches in the tissues, and it is impossible to withdraw it without increasing the size of the wound considerably. The simplest plan of treatment is to push on the hook and make it protrude through the skin elsewhere to such an extent as to enable the barb to be cut away, when the remainder of the hook will be set free.

For the detection of penetrating foreign bodies of a metallic nature, or of splinters of glass or stone, the so-called X rays of Röntgen are exceedingly valuable. They are produced by passing a powerful electric current through a modified Crookes tube, or, as it is now termed, a 'focus-tube.' This consists of a thin glass bulb, into which are fixed two terminals—one, the negative or kathode, concave, and the other, or positive pole, a platinum plate set at an angle, from which the rays are given off. A very high vacuum must be present in the tube. The rays thus generated, though invisible to the naked eye, have an actinic power, and are capable of affecting a photographic plate in the same way as ordinary sunlight. They are also able to penetrate many substances which are impermeable to ordinary light, although others resist their passage. Most of the soft tissues of the body are readily traversed, but bones and to a much less degree tendons are sufficiently resistant to cast a shadow on the plate, and it is the fixation of these shadows that constitutes the peculiarity of the so-called 'skiagram.' If a limb with a supposed foreign body within it is placed over a sensitive dry plate, held in a non-metallic dark slide or a black envelope, and the tube just above it, so that the convex portion on which the rays impinge is nearest the limb, a skiagram is produced which, on development, shows the osseous tissues, the outline of the limb, and the foreign body, if it exist (Plates III. and IV.).

A modification of this process has led to the production of the **Cryptoscope**. This consists of a cardboard screen coated with platinocyanide of barium, and if employed instead of a sensitive plate on the further side of the limb to the tube, the appearances produced can be seen by the naked eye. Since it is possible in this case to move the limb from side to side, or to rotate it, a better idea can be obtained of the position of the foreign body; by simple skiagraphy, it is often difficult to tell on which side of a bone the foreign substance lies. Still better results have been obtained by the application to this method of the principle of the stereoscope. Special methods of localizing foreign bodies have been introduced of late, but they are too complicated to be referred to here.

IV. **Gunshot Wounds.**—It is impossible in a work such as this to go minutely into the subject of gunshot wounds, but it is essential to indicate their most important features, and in what respect they differ from other forms of injury already described. The character

PLATE III.

SKIAGRAM OF HAND, WITH NEEDLE EMBEDDED IN THE PALM, CLOSE TO THE CARPUS.

nshot wound varies according to the nature of the projectile, employed, the velocity of the missile, the distance from the which the firearm was discharged, the part of the body and the direction of the shot.

wounds inflicted by the **modern small-bore rifle** (*e.g.*, the Lee-l, Mauser, or Krag-Jorgenson) are very different to those d in former days. The desiderata that have been considered volution of the modern rifle have been to secure great muzzle , a low trajectory, and clean and hard hitting. To this end rel has been rifled so as to cause the bullet to rotate on its ngitudinal axis (without such rifling the bullet would rotate short axis), and the bullet has been greatly modified, whilst form of gunpowder has given way to more highly explosive ces.

modern bullet is a long, thin, conical body, consisting of of lead hardened by the addition of 2 per cent. of antimony, d in a cover, jacket or mantle of some smooth, hard metal, per cent. of copper and 20 per cent. of nickel (Lee-Metford auser). The muzzle velocity is very high, amounting to eet per second for a Lee-Metford rifle, and 2,300 feet per for a Mauser. The trajectory is nearly flat; anything within rds may be fired at point-blank, whilst in a range of 2,000 he bullet only rises 194 feet, as compared with 866 feet with der bullet.

effect of these arms varies to some extent with the range, but rly so much so as was formerly maintained; and although rst wounds are usually produced at a short range, say 500 or rds, yet quite simple wounds with no disruptive phenomena so be caused at a similar distance. One of the best-marked s of these wounds is that the bullet travels straight and direct, t lateral deviation or deflection, as was so commonly the case old days. Simple flesh wounds are of no great importance granted that important vessels and nerves are not injured. perture of entry is small, and looks somewhat like a bug the aperture of exit is slightly larger, and tends to be a little slit-like. A certain amount of extravasation occurs into the around the track, but the external bleeding is often slight. is but little tendency to carry in portions of clothing or septic al, and the wound heals by first intention if reasonable pre-ns are taken. The external cicatrices finally look very similar e produced by bad acne pustules. Vessels and nerves are ely to be injured unless they are actually in the line of the the accurate limitation of the damage to this line is evident ne hears of a bullet passing between the abdominal aorta and na cava without either being injured. If a large artery is hit, the patient bleeds freely, and may die of haemorrhage, it can be controlled by a tourniquet. If the artery is button-a traumatic aneurism may result, whilst arterio venous wounds ommon in the South African campaign. There has been some

difference of opinion as to the character of the injuries to bones; that large masses of cancellous tissue (*e.g.*, the lower end of the femur) can be drilled cleanly without fracture is certain; but such wounds are sometimes associated with much splintering and involvement of neighbouring joints, possibly as a result of a short range, or of expansion of the bullet from the tearing down of the mantle. If a bullet hits cleanly the compact shaft of a long bone, it may smash the whole bone into small fragments, or the force may be more localized in its action, though always severe. Such comminuted wounds are very likely to become septic, if there is a long transport to the field hospital, and then fragments undergo necrosis and serious inflammatory phenomena follow.

Head wounds are much less fatal than might be imagined from the experimental work that has been undertaken. At close range frightful disruptive effects are produced, which are almost certain to be fatal (see Chapter XXV.); at a longer range comparatively little mischief is done, except along the line of the missile. The inner table is always more splintered than the outer, and of course a certain amount of brain substance may escape. Abdominal wounds are also much less serious than formerly, a mortality of 90 per cent. (American Civil War) being replaced by one of 40 per cent. in the South African campaign, and that without operation (Treves). The mere penetration of one or more coils of intestine is not sufficient to cause general peritonitis; the wound is very small, and peristalsis seems to come to an end entirely as soon as the patient is struck, so that neighbouring coils of intestine or the omentum suffice to prevent fæcal extravasation; indeed, many of the patients suffer but little constitutional or local disturbance. Of course, an empty intestinal canal is a favourable condition, and this is not unfrequently present on the field of battle. Bloodvessels may be wounded in the mesentery and death result from hæmorrhage; solid viscera, such as the liver or spleen, are often damaged but little, granting a fairly long range. On the whole, the effect of these modern bullets is to disable without killing, unless a vital part is struck.

Soft-nosed Bullets (*e.g.*, the Dum-Dum) are characterized by the mantle being absent at the top, whilst the lead core is usually free from antimony. The result of this is that as soon as the bullet strikes, the lead core mushrooms out, and terrible mutilation or destruction of surrounding tissues ensues, whilst bones are comminuted and solid viscera pulped. A similar result follows from rubbing or cutting off the top of the Lee-Metford or Mauser bullet or even from incising the cover in two or three places.

Martini-Henry and Snider Bullets produce wounds which are intermediate in their severity between the preceding two. The aperture of entry is usually small, that of exit large and with everted edges. Portions of clothing are frequently carried in by these missiles, and add to the risks of sepsis.

Shell Wounds have no special peculiarities beyond their severity and the ghastly nature of the injuries which may be inflicted by

them, depending on the irregular shape of the fragments into which the shell bursts.

Dangerous wounds may be inflicted by small shot, as, for instance, when one of the pellets enters the eye, whilst the wads or other portions of the cartridge may also be carried into the body. A blank cartridge, if discharged at a short distance, may produce a severe wound, and under such circumstances the skin around is likely to be burned and blackened, leaving a permanent bluish-black tattooing of the tissues.

The **Treatment** of gunshot wounds is conducted in accordance with general surgical principles, although it may have to be somewhat modified by the patient's environment and by the fact that after a battle the pressure of work may be such that all lengthy operative procedures have to be discarded. The first essential is to protect the wound from infection, and for this purpose the small packet of antiseptic dressing carried by all our soldiers is admirable. Bleeding is, if possible, controlled by a tourniquet; and splints must be improvised for broken limbs, if practicable. As soon as the wounded man reaches the field hospital, the wound is more thoroughly explored and cleansed; foreign bodies are removed, bleeding-points secured, and if the bullet has not escaped and can be readily detected, it should be extracted. When lodged deeply, various appliances have been introduced to locate the exact position of a bullet, *e.g.*, Nelaton's porcelain-ended probe or more complicated electrical contrivances, such as the telephone probe. Skiagraphy has also a large field of usefulness before it in this direction. Comminuted fractures are carefully investigated, detached fragments of bone are removed, and if an attempt is made to save the limb, splints, etc., are carefully applied. Primary amputations for bullet wounds are not very common at the present day, except when great comminution of bone or hopeless involvement of vessels and nerves has occurred. Wounds of the skull always demand the most careful attention; even when the bullet has penetrated cleanly and escaped, each opening must be trephined so as to allow of the removal of depressed splinters of the inner table. This rule holds good even when a bullet has merely ploughed a groove or track along the calvarium without penetration. The results of such treatment have been most admirable.

The treatment of abdominal wounds produced by small-bore rifle fire is generally one of expectancy. It has now been abundantly proved that patients can recover in the most astonishing fashion from bullet wounds which have traversed the abdomen from side to side or from front to back, and therefore unless there is some very clear indication, operation is better avoided. Moreover, the practical difficulties connected with abdominal sections, the frequent lack of sterilized water, of towels, and the dirty condition in which the patient is, owing to the exigencies of the campaign, together with the length of time that such an operation takes—all these constitute reasons for not interfering unnecessarily. Abdominal distension from hæmorrhage is one of the chief indications for

laparotomy. In civil practice the ordinary rules of treatment are followed (Chapter XXXIV.).

V. **Poisoned Wounds.**—The great majority of poisoned wounds are due to some definite micro-organism, and we have discussed their nature and characteristics elsewhere. A few only remain to be dealt with here.

Stings of Insects, such as bees and wasps, may be exceedingly irritating and painful, but are not dangerous, unless some local complication, such as erysipelas, supervenes, or the stings are very numerous, as when a swarm of angry bees settles on a person, or the part involved is such as to lead to serious swelling, as in the pharynx or tongue, œdema of the glottis possibly arising under such circumstances. All that is usually needed is the application of a weak alkaline lotion, whilst a common and efficient domestic remedy is a sliced fresh onion applied to the part. Care must also be exercised to ascertain that the sting and poison sac are not left in the body.

Some varieties of flies and spiders are also extremely virulent, and it is now certain that several forms of disease are conveyed by the former. Thus, if a fly bites a person after feeding on putrid carrion, some form of septic inflammation may be originated; anthrax may also be spread in this way. Mosquitoes, too, play an important rôle in the development of malaria and filariasis.

Snake-bites require but little notice here, as they are exceedingly rare in this country, the common adder (*Pelias berus*) being the only venomous one likely to be met with, and even with this the poison is not sufficiently virulent to do much harm unless the individual attacked is a child or a person in a very bad state of health. The poison is conveyed to the wound from the glands and poison sac situated on either side of the upper jaw through fine canals in the specialized teeth, which open at their apices; these teeth are so delicate in some snakes that it may be difficult to find the wounds produced by them. The effects of an adder's bite are not, as a rule, noticed immediately, but come on in the course of an hour or so; extreme prostration supervenes, with a weak pulse, cold clammy perspiration, dilatation of the pupils, and perhaps delirium in bad cases, merging into coma.

The **Treatment** consists in preventing the absorption of the virus by tying a ligature firmly above the wound, which should then be laid open so as to allow of free bleeding, and the surface excised or cauterized. The collapse resulting from absorption of the poison is best remedied by the administration of stimulants or the hypodermic injection of strychnine.

In India and other countries many varieties of poisonous snakes are met with, and wounds are frequently fatal; indeed, in India it is stated that 12,000 individuals are yearly destroyed in this way. The symptoms come on rapidly, and are extremely severe, although they are modified according to the variety of snake. The treatment

must necessarily be more energetic; probably the introduction of Fraser's antivenine will be the means of saving life.

The **Anatomical Tubercle**, or **Butcher's Wart** (*Verruca necrogenica*), consists in a papillomatous development usually on the knuckles or wrists of those who are exposed to wounds either in the deadhouse or slaughter-house. It is in all probability a manifestation of tuberculous infection, and, indeed, resembles somewhat closely the appearance of lupus when it develops on the hands. Treatment consists in the application of a powerful caustic, whilst in bad cases it is necessary to scrape the surface before cauterizing.

Dissection or **Post-mortem Wounds** have obtained an unenviable notoriety in the production of serious inflammatory disturbance. It is well known that bodies are most virulent within a few hours of death, and hence the post-mortem room is more frequently responsible for these affections than the dissecting room; the care now exercised upon the preparation of subjects has greatly reduced the dangers due to the latter source. Inflammatory disturbances may arise from several distinct causes:

1. The presence of strong antiseptics, such as arsenic, often irritates abrasions, and causes tenderness and congestion of the matrices of the nails.

2. The organisms occurring in actual putrid material have no power of attacking living tissues, although some irritation may be caused by them if small sores or abrasions are present.

3. Pathogenic organisms are frequently found in bodies soon after death, and are especially virulent when developing in the exudations from serous membranes, such as the peritoneum; hence both the surgeon who operates on the living subject, and the pathologist who examines the body after death, are alike exposed to serious risk either from an accidental puncture or from the infection of some abraded surface. It is even possible for infection to occur through the hair follicles of an unbroken skin.

The resultant lesions necessarily vary much in their nature. In the simpler cases all that ensues is a limited irritation of some abrasion or scratch, which rapidly disappears on the application of some sedative or antiseptic lotion. Suppurative folliculitis, or even boils, arise from infection of the hair follicles, and in worse cases the various forms of onychia, paronychia, or diffuse cellulitis, with or without suppuration in the nearest lymphatic glands. Severe toxæmic symptoms usually accompany the last-named conditions, and even acute septicæmia may develop.

The immediate treatment indicated for a dissection wound is to tie a ligature or handkerchief around the base of the wounded finger, so as to encourage bleeding and prevent the absorption of toxic materials; the part is then well washed under a tap of cold water, immersed in an antiseptic solution, and sucked for some minutes; an antiseptic dressing must then be applied. Any inflammation which arises subsequently must be treated according to the general rules of surgery.

A common result of poisoned wounds of the fingers, whatever their origin, is inflammation of the nail matrix (Chapter XVI.), or of the tissues of the fingers, constituting a whitlow; and it will be convenient to describe the latter condition at this place.

A Whitlow (*Paronychia* or *Panaritium*) occurs in four different forms, of which one is a true cellulitis, another a teno-synovitis, a third is a localized inflammation of the skin, and the fourth involves the terminal phalanx.

(*a*) The **Subcuticular** whitlow consists merely in a development of pus beneath the cuticle which separates it from the cutis vera. It is very painful, but otherwise is of little importance. A boracic poultice, preceded by the removal of the loose cuticle, is all that is needed in its treatment.

(*b*) The **Subcutaneous** whitlow is a true cellulitis, commencing in the pulp of a finger, but often spreading upwards to involve the palm. The finger becomes swollen and painful, the pain being increased by pressure or by hanging down the arm. Gradually both these symptoms increase in amount, the back of the finger becoming œdematous, and the pulp more or less red. The swelling is at first hard and brawny, and even when pus is present it may be difficult to detect fluctuation unless the abscess is nearly pointing. Constitutional symptoms are not, as a rule, very severe, though the intensity of the pain may exhaust the patient. The hand should be elevated, and the finger poulticed. A free incision should be early adopted, but, though free, must not extend too deeply, or the tendon sheath may be opened and infected. Occasionally the pus forms at one or other side of the finger, and the incisions must then be suitably modified. Antiseptic fomentations may be continued after such an incision, the constant moisture adding greatly to the patient's comfort.

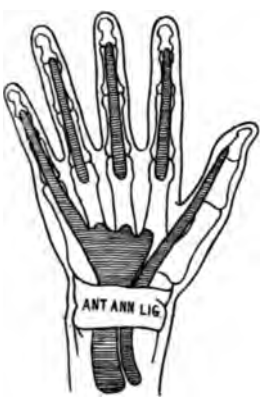


FIG. 64. — DIAGRAM OF SYNOVIAL SHEATHS OF FLEXOR TENDONS OF HAND.

(*c*) The **Thecal** form of whitlow is really a suppurative teno-synovitis of the flexor sheaths. The signs are much the same as in the former variety, only more severe, because the process is often more extensive. As special features may be mentioned the inability of the patient to bend the finger, and the extreme pain caused on attempting to do so, owing to the involvement of the tendon. The swelling also is more marked, and usually extends to the dorsum of the hand. The arrangement of the synovial sheaths in the fingers and palm is indicated in the accompanying diagram (Fig. 64), from which it is obvious that whitlows of the thumb and little finger are more dangerous than those of the intervening fingers. In the last case suppuration ceases at the level of the heads of the metacarpal bones; but occasionally it oversteps this limit, and involves the palm in the same way as in the thumb and little finger. Free and early incision must be made to anticipate such extension, and also to limit as far as possible the adhesions which the tendons are liable to contract, or to prevent them from sloughing owing to the acuteness of the inflammation. In neglected cases the pus may burrow to the dorsum of the fingers, necessitating counter-openings; or the periosteum may be affected, leading to disease or death of the phalanges; the interphalangeal joints may also be disorganized. If the palm is involved, one usually endeavours to spare the superficial palmar arch and its branches, but in bad cases an incision is made down the centre of the palm irrespective of vessels, inasmuch as the superficial arch is easily picked up and tied. The incision should be made along the middle of the metacarpal bones involved, and not higher than the centre of the palm; but an opening may also be necessary close to the

level of the wrist-joint, and this can be made in the middle line without danger.

(3) The **Subperiosteal** whitlow may be merely a complication of the thecal variety, but it occasionally starts as an acute necrosis of the terminal phalanx, arising either idiopathically or as a result of infection from the nail matrix. The inflammation may be limited to the end of the finger, or may spread to the palm. Free incisions, and the removal of the bone, if dead, constitute the treatment required.

Repair of Wounds.

In former days five different methods of repair were described, but increased knowledge and further research warrant us in making the statement that there is but one method of repair, which, however, is modified according to the conditions of the wound, and that this process is essentially the same whatever tissue of the body is involved, be it bone, muscle, tendon, or subcutaneous connective tissue. It must be noted that repair is not synonymous with regeneration. It is very unusual for any tissue which has suffered from a serious lesion to be regenerated; fibro-cicatricial tissue, or some modification of it, forms the new bond of union between the damaged parts. In a few tissues, however, true regeneration has been noted—*e.g.*, in striped muscle, bone, tendon, nerves, and glandular structures, provided the injured parts have been brought into close apposition.

The **general facts as to the process of repair** may be stated as follows: The margins of the wound are always bounded by an area of tissue in a state of lowered vitality, even if no bruising or sloughing of the parts is present. The divided vessels are in a condition of thrombosis as far as the next patent branches, which in their turn are slightly dilated, partly as a result of this obstruction and partly from the reflex irritation of the injury. The surface of the wound is generally covered with a film of lymph or blood-clot, whilst any spaces left in the interstices of the tissues are similarly occupied.

(1) The first stage in the process consists in an abundant *exudation of small round cells*, presumably leucocytes, whose function is to remove all dead or damaged tissue, as well as to break up, disintegrate, and finally absorb, any blood-clot which is present. These cells are derived from the surrounding vessels, and are accompanied by a certain amount of serous oozing, so that we have here the early manifestations of a slight inflammatory reaction, which, if it does not extend beyond certain limits, is a beneficial proceeding. Should it, however, become excessive, as when bacterial invasion is present, injurious results may follow. Much discussion has arisen among pathologists as to whether or not this stage of repair is to be considered inflammatory in origin; the phenomena are, however, so exactly similar to those occurring in the earliest stages of inflammation that it is impossible to draw any line of distinction between them.

(2) The exudation of leucocytes is soon followed by the appearance of a number of large oval cells with abundant protoplasm and

large vesicular nuclei (Fig. 65, D); these are termed *fibroblasts*, and are the cells which undergo organization to form fibrous tissue and bloodvessels. There is some difference of opinion with regard to the origin of these cells; the earliest idea was that they were migrated leucocytes, but this was abandoned in favour of the theory that they are derived from the cells composing the tissues of the part, being either connective-tissue corpuscles or endothelial cells

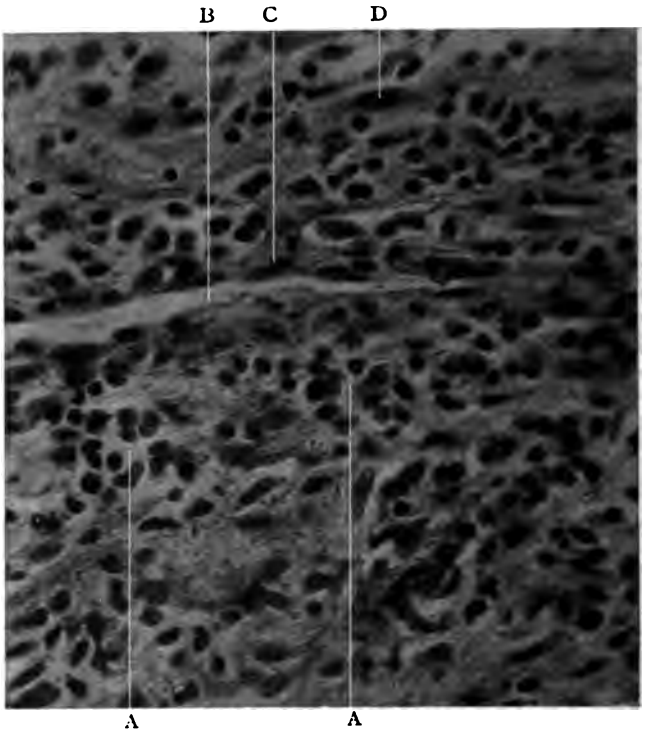


FIG. 65.—GRANULATION TISSUE (EARLY STAGE).

A, A, are collections of 'small round cells": there are many others scattered through the section; B is a newly-formed vessel; C its endothelial wall; D is a fibroblast.

lining the capillaries, lymphatics, or lymph-spaces. But the ingenious researches of Ziegler and his school, who inserted into the peritoneal cavity glass chambers composed of two pieces of thin cover-glass, cemented a short distance apart, and watched the process of organization in this narrow space, have shown definitely that some at least of the fibroblasts are wandering cells derived from the blood: it is possible that these cells are in their turn derived from the endothelium, and that the endothelial cell is the fibroblastic

cell *par excellence*. Whatever their origin, they soon form a layer of cellular tissue which lies upon or between the surfaces or lips of the wound, whilst the previously effused leucocytes disappear, some finding their way back into the circulation, and others serving as pabulum for the nutrition of the fibroblasts.

(c) The *vascularization* of this cellular layer forms the next stage in the process. This is brought about by the outgrowth from the walls of the nearest capillaries of solid rods of protoplasm (Fig. 66, *a*), which appear first as minute buds, but rapidly increase in length, and may be single or double. They soon bend over to unite with similar threads growing out from other capillaries, or with the wall of another vessel (Fig. 66, *b*), or occasionally they unite with the vessel from which they started. The connective-tissue cells may also become spindle-shaped, and send out branching processes to

FIG. 66.—NEW VESSEL FORMATION. (After Tillmanns.)

a small bud-like projection from the wall of a capillary; *b*, the union of such buds one with another, or with the branching processes of connective tissue cells; *c*, the canalization of these processes.

unite with the offshoots from the vessel walls. After a time these protoplasmic threads become canalized (Fig. 66, *c*), and a communication is established between them and the mother vessel, so that blood passes into them. The new capillary wall, at first homogeneous, soon becomes lined with definite endothelial cells, and strengthened by the connective tissue which forms around it. By this means a soft vascular tissue is produced, known as *granulation tissue* (Fig. 65), consisting of loops of capillaries supported by large nucleated cells with a varying amount of intercellular substance, which soon becomes fibrillated in texture.

(*d*) The *transformation* of this granulation tissue into *fibro-cicatricial tissue* is next proceeded with. The fibroblasts become spindle-shaped, and finally long and narrow, with pointed extremities, which often branch (Fig. 67); the nuclei also become long and narrow, and lose their vesicular appearance. The next stage of the process is open to doubt. The most probable view is that the periphery of the cell becomes converted into collagen, and is then split off from the

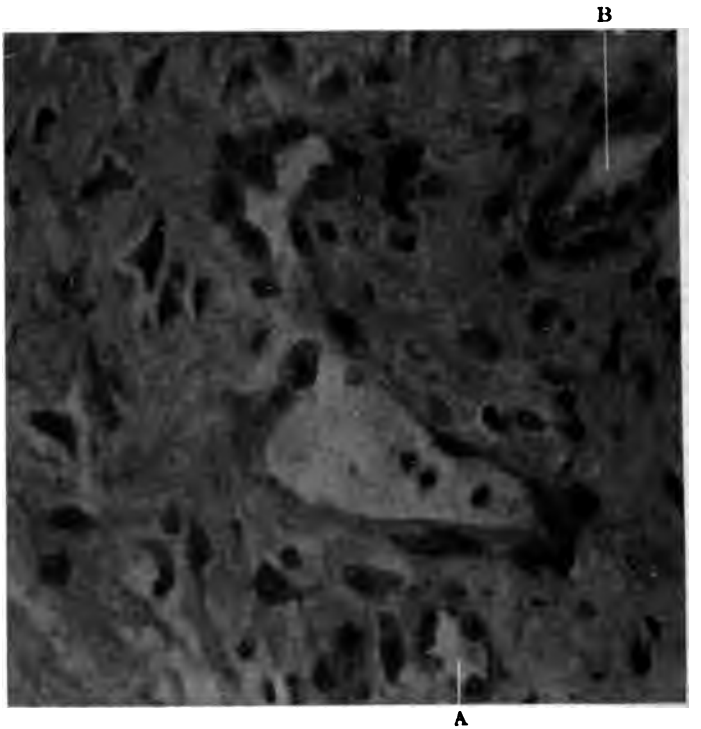


FIG. 67.—GRANULATION TISSUE IN A LATE STAGE OF ORGANIZATION FROM BELOW THE FLOOR OF A HEALING ULCER.

A is a young vessel of new formation; B, a vessel in a higher state of organization. The stroma between the vessels consists of loose fibrous tissue in which numerous fibroblasts are embedded; there is a strong resemblance between these and the endothelium lining the vessels.

mother cell to form a fibril of connective tissue; this process is repeated until almost the whole of the protoplasm is used up, the nucleus and a small area of protoplasm remaining as a connective-tissue cell, or as an endothelial cell lining a lymph-cleft. An alternative theory is that these fibrillæ are formed as an intercellular exudation. By the contraction of these fibres the cells

become flattened out and compressed, and the newly-formed vessels constricted, so that as time passes the scar tissue becomes less and less vascular, and consequently firmer and denser, as well as smaller.

(c) Whilst this last stage is in progress, the surface of the wound is covered over with cuticle, which spreads inwards from healthy epithelium in the neighbourhood of the wound, and especially from the deeper layers of the rete Malpighii.

As already stated, the general process of repair sketched above is modified according to the character and condition of the wound. Four chief modifications are met with in surgery:

1. **Healing by First Intention** or **Primary Union** occurs in cleanly-cut aseptic wounds where the lips are unbruised and brought

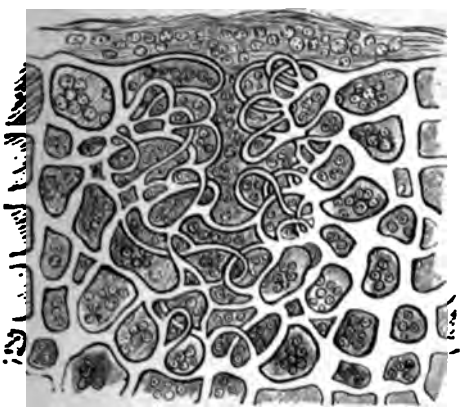


Fig. 68.—Diagram of Healing by First Intention. (After Billroth.)

The wound is occupied by a fibro-cellular growth, into which loops of capillaries extend, constituting granulation tissue, whilst the epithelium has united across the surface.

together, so that no extensive collection of blood or discharge between them is possible. A thin layer of blood-clot lies between the surfaces of the wound and penetrates into its meshes, and the contraction of this clot is at first the chief means of keeping the deeper parts in apposition. There is but a microscopic line of damaged tissue, which, together with the blood-clot, is easily absorbed, and the process runs a typical course, as sketched out above, union being effected in five to seven days. (See Figs. 68 and 69.)

2. **Healing by Granulation,** or second intention, as it used to be termed, is met with (*a*) in cases where there has been definite loss of substance, so that the lips of the wound are not, or cannot be, approximated; as also (*b*) when the surface of the wound is bruised or damaged so that portions of tissue have to separate by sloughing; or (*c*) when the advent of sepsis has prevented the occurrence of primary union.

When a small amount of aseptic dead tissue is present, removed, as previously described (p. 96), by an invasion of leucoc from the surrounding vessels, which disintegrate and grad absorb it. These are followed by the fibroblasts, which form a l of granulation tissue on the surface of the wound (Fig. 70). there is much slough to be dealt with, the vitality of the granul tissue cannot be maintained beyond a certain distance from source of nutrition, and so by a process of simple anæmic ulcera the unabsorbed dead portion is cast off and a granulating sur

FIG. 69.—SECTION OF A WOUND HEALED BY FIRST INTENTION TEN DA AFTER ITS INFLICTION.

The epithelium is drawn in to form a V-shaped notch, and beneath is a m fibro-cicatricial tissue with comparatively few cells or vessels evident.

remains. If the slough is septic, ulcerative inflammation occu the adjacent living tissue, which brings about a similar re though accompanied by suppuration and septic fever. When, h ever, there is a simple loss of substance, with no bruising or dam to the tissues, the course of events is as follows: The blood-str in the superficial capillaries having been arrested, adjacent ve become dilated, and from these an exudation of plasma and le cytes results. The plasma coagulates on the surface and for layer of fibrin, entangled in the meshes of which are a numb white corpuscles, so that the wound becomes covered with a fil whitish-yellow material known as lymph. This gradually incr

deep channels made in the treatment of bones thickened by chronic osteitis. Blood is allowed to collect and coagulate so as to fill the cavity, and the surface is covered with protective to prevent irritation from the dressings. The dark coagulum shows no trace of change for some days, but gradually the peripheral portions become granular and yellowish-white in colour; these are gradually vascularized and transformed into granulation tissue, which in time spreads over the whole surface from periphery to centre, and then healing occurs as described above. The clot is absolutely passive in this process, being infiltrated by leucocytes and removed by degrees, and thus

FIG. 71.—SCAR FROM A RECENTLY HEALED SUPERFICIAL WOUND (LOW POWER).
The epithelial surface is regular and devoid of papillæ; the scar tissue has an abundance of cells scattered through it, as well as some very obvious vessels, which would almost entirely disappear at a later date.

merely serves as a basis of support or scaffolding for the building up of the granulation tissue which replaces it.

A **Scar** is a mass of fibroid tissue covered by epithelium, which has been formed in the repair of a wound (Figs. 69 and 71). It is at first vascular, and contains cells of the connective-tissue type; but after a time, as contraction continues, the cell elements become flattened out, fewer in number and less obvious, the intercellular fibrous tissue more abundant, and the vessels constricted, so that finally a scar becomes well-nigh bloodless. Where superficial, its colour changes from red to white, and if of small size it may almost

disappear, but never absolutely, unless the subcutaneous tissue has not been involved. When the parts around become injected by any cause, such as sharp friction, the anæmic scar tissue again becomes evident by contrast. Lymphatics, nerves, hairs, and cutaneous glands are all absent, except perhaps at the periphery, and the epithelial covering itself is merely a uniform layer without papillæ.

The **Pathological Phenomena** connected with scars are as follows:

1. **Excessive Contraction**, which may lead to great deformity, especially when the wound has occurred in the flexure of any of the joints. A web-like mass of fibroid tissue then forms, limiting movement, and requiring operative interference. A seriously burned hand may by cicatricial contraction be fused into an unsightly mass, rendering the fingers of little use; similarly, the chin may be drawn down and practically fixed to the sternum, and the lower lip everted, as the result of a burn on the front of the neck. The *Treatment* of such conditions consists in dividing the cicatrix, and thus freeing the parts, during which process it must be remembered that deeper structures of importance, such as the main vessels and nerves, may be adherent to the under surface, and thus be endangered. When once the scar has been divided, there is often no difficulty in restoring the parts to their normal positions, although when the contraction has existed for any length of time it may be advisable to do this slowly, even by gradual extension with a weight and pulley, so as to avoid any risk of lacerating the deeper parts, which are usually contracted secondarily. The raw surface formed by the opening out of the contraction has now to be covered with epithelium by some form of skin-grafting or by a plastic operation; most of the cases can be dealt with by Thiersch's method (p. 91), but the results, though promising for a time, are often ultimately disappointing.

2. **Overgrowth of the scar tissue** is sometimes met with, constituting what is known as the false or **Alibert's Keloid**. This most frequently occurs in the scars of burns or of wounds in tuberculous patients, but may arise from any cicatrix, presenting itself as a fibroid indurated mass of a dusky red colour, with perhaps a number of dilated vessels coursing over it, which occupies the region of the old scar, and may possibly send claw-like processes into neighbouring healthy structures. It consists merely of a hyperplasia of the scar tissue, but as to its ætiology nothing is known. With the exception of somewhat severe pruritus or itching, its presence entails no inconvenience, although if it occurs on exposed parts it may be very disfiguring. Removal is useless, since the keloid almost always recurs in the new cicatrix and in the stitch holes. After a longer or shorter interval it often disappears spontaneously.

3. **Ulceration of Scars**, the result of defective nutrition, is a troublesome condition to deal with, as repair is usually slow.

4. **Painful Scars** arise from either the implication of a nerve terminal in the cicatrix, or the pressure of a contracting scar upon the bulbous end of a divided nerve, as in amputation stumps. In each case further operation is necessary; in the former the cicatrix, or at any

rate the painful portion of it, is excised, whilst in the latter the stump must be opened up, and the enlarged end of the affected nerve removed.

5. **Malignant Disease of Scars**, or of old chronic sores but partially healed, is of an epitheliomatous type, and appears as a hard ulcerated tumour with everted edges, a thickened base, and usually a good deal of fœtid discharge (*Marjolin's ulcer*). The progress is very slow, since the vascularity of the tissue is slight. It is painless, from the absence of nerves, and as long as the disease is limited to the scar, no lymphatic implication will be noted. As soon, however, as the malignant growth invades healthy tissues, the usual phenomena show themselves. The diseased tissues may be freely dissected out, having regard to subjacent structures, and the wound closed by some plastic method.

General Conditions connected with Wounds.

I. **Shock.**—By the term 'shock' is meant a general depressed condition of the nervous system, resulting from some energetic stimulus, which is either transmitted to the vital centres in the medulla from the peripheral sensory or sympathetic nerves of an injured part, or may descend to them from a disturbance of the emotional centres through the nerves of special sense. **Local Shock** is a curious condition of insensibility to pain on handling, which is sometimes present after severe injuries, and is especially seen in gunshot wounds. Possibly it is due to some temporary paralysis of the sensory nerves.

The term **collapse** is applied to a condition very similar in nature to shock, but differing from it mainly in its onset, which is gradual, and often preceded by some exhausting disease, and by the fact that muscular relaxation is more complete. The collapse of cholera is one of the most typical manifestations, but any condition associated with loss or derivation of fluids from the vessels may give rise to it—*e.g.*, prolonged vomiting or serious hæmorrhage. If at the same time septic absorption is taking place, the symptoms are still more marked; thus in acute peritonitis the two factors, removal of fluid from the circulation and toxæmia, are proceeding concurrently. Shock usually tends to recovery, unless the lesion is of a serious nature, and then collapse may supervene and prove fatal; thus, after rupture of the intestine the immediate symptoms are the result of shock, but they are quickly followed by the collapse due to acute peritonitis.

The **degree** of shock experienced in any particular case is mainly influenced by the following factors:

(*a*) The *severity and extent* of the injury. Speaking generally, the amount of shock varies directly with the depth of the wound, since the deeper the wound, the greater the violence which has produced it; but in some cases extensive superficial wounds produce a more severe effect than limited deep ones, owing to the larger number of nerves involved, along which stimuli can be carried to the centres; thus, an extensive superficial burn is more likely to produce fatal shock than the complete incineration of an extremity.

(*b*) The *site* of the injury. The more essential and sensitive the

organ injured, and the more closely it is connected with the vital sympathetic or cerebral centres, the greater will be the shock. Thus a small wound of the intestine, stomach, or any of the viscera is more serious than an extensive accident to the limbs.

(c) The ***nervous susceptibility*** of the patient is a most important element, for the more highly organized the nervous system is the amount of shock experienced, and the more prolonged and continued suffering may render an individual less capable of resistance as usual, especially if sedative drugs have been employed. Thus surgeons find that amongst the coarser and lower types of humanity operations may be performed without an anæsthetic in a satisfactory manner.

(d) The ***expectation or not*** of the injury. When the nervous system is maintained in a state of tension, as when waiting in expectation of some painful impression, the effects of shock are greatly increased; whilst if the attention is diverted, and the mind is occupied in other things, the shock at the time is slight, although its effects may be subsequently greater. Thus in the case of excitement and nervous tension of a battle, a soldier may be severely wounded severely, and yet not known at the time, whilst a prick or the most trifling cut may produce deep shock when the patient is in a state of dread and anticipation.

The **Symptoms** vary with the injury and the patient, from momentary giddiness and faintness (known as shock) or a syncope or a fainting fit) to immediate collapse, insensibility, and even death. The pulse is at first small, rapid, weak, but soon becomes irregular, extremely rapid, and imperceptible; the countenance is pallid and shrunken, the surface covered with cold sweat; the respirations are shallow, and the temperature is usually subnormal.

After an interval, the length of which depends on the severity of the lesion and the treatment adopted, *reaction* occurs, being marked by increased depth and frequency of the respirations; the pulse becomes slower and fuller, the surface warmer, whilst consciousness and muscular power are gradually restored. During this period it is not unusual for an attack of vomiting to supervene, probably due to hyperæmia of the brain following the anæmia which has been responsible for most of the preceding symptoms.

When serious loss of blood has also occurred, the phenomena of hæmorrhage are associated with those of shock; the pulse is sometimes of the hæmorrhagic type (p. 272); the blood is altered in its characters, and great restlessness may be present.

Sometimes reaction is accompanied by irritability, either of the mental or muscular systems, in the one case leading to traumatic delirium, which is always of grave import, and in the other to intense restlessness, as in the shock which follows extensive burns. It is possible that in both these conditions a toxic element has been superadded. The term *erethitic* shock is sometimes applied to these manifestations.

Occasionally the evidences of shock are delayed in their appear for some time after the injury, and come on gradually. Especial this the case after railway accidents when no great injury has experienced; for a time the anxiety and excitement are such th depression is noticed, but as the mental perturbation passes of individual experiences symptoms very similar to the above, probably rather of the nature of neurasthenia than of real shock Chapter XXIII.). When an accident occurs to a person in a of intoxication, it is not unusual for the phenomena of shock t delayed for some time, only showing themselves when the effe the alcohol has passed away.

Pathology.—The *post-mortem* evidences are not very character but they all point to a loss of control of the nervous system ove vascular, resulting in anæmia of the brain and superficial parts o body, and enormous engorgement of the abdominal viscera, l and great venous trunks; the heart contains practically no b although it is probable that the right side is much distended a time of death, especially when due to sudden injury, and subsequ empties itself by post-mortem contraction. The *explanation* o phenomena of shock is by no means simple, and several factor probably needed to produce the complex result. 1. Reflex inhib of the heart's action through the cardio-inhibitory centre in medulla explains the early syncope with slow pulse. It is well kn that if a frog's abdomen is opened and the exposed intestine sh struck, the heart stops in a condition of diastole, whilst if the va previously divided, no effect is produced. Any severe perip injury may lead to such a result, especially those directed to the sympathetic centres in the abdomen which are closely connected the vital centres in the medulla. In this way sudden death m produced by a severe blow in the epigastrium, or by drinking a of very cold water, when hot. This inhibition of the heart's acti never prolonged in mammals. 2. Exhaustion of the vasomotor c in the medulla is probably the chief cause of shock, by leading marked fall of blood-pressure. Crile,* who has most carefully st this subject, shows that stimulation of the central end of a div nerve causes a rise of blood-pressure at first; but if the stimulati repeated often, this rise gradually diminishes, disappears, and in is represented by a fall. This depression is provided for by a ne mechanism, which opens up the splanchnic area and allows the b to collect in the larger veins of this region. The supply of blo the brain and surface is therefore diminished, the portal system b over-full. It is also obvious that any considerable hæmorrhag aggravate the vascular trouble.

Diagnosis.—1. From the general results of *hæmorrhage*. Res ness and thirst are then prominent signs, together with a sen dyspnœa, causing rapid respiratory efforts; the mental cond moreover, is less affected, and the patient is generally sensible

* 'An Experimental Research into Surgical Shock,' by G. W. Crile. Lippincott Co., 1899.

surface is excessively blanched, and the pulse may have a marked hæmorrhagic wave. 2. In *concussion of the brain* there are superadded to the symptoms of shock those more particularly connected with the region affected, *i.e.*, the intellectual centres, so that unconsciousness is the predominant feature, whilst loss of memory of the accident and of the events which followed is often noticed. 3. When *vomiting* is approaching *under* the influence of *an anæsthetic*, the patient's pulse usually becomes weak and rapid, and the countenance pale. This condition closely simulates shock, and is often distinguished from it only by the progress of the case. Under such circumstances, if vomiting is plainly imminent, it is sometimes wise to increase the amount of anæsthetic, as the patient is usually not fully under its influence.

Treatment. In slight cases very little is needed beyond resting quietly for a few minutes, or the exhibition of some aromatic stimulant to the nostrils, such as ammonia or smelling-salts. In the more severe cases the patient is laid recumbent, with the head low; hot bottles, well protected, and blankets are applied to the trunk and extremities to maintain and increase the bodily temperature. If able to swallow, a little warm tea or stimulant may be administered; but if unconscious, a hot coffee or brandy enema, small in bulk, or a hypodermic injection of ether or strychnine (m. v.-x. of the B.P. injection), is necessary. It must be borne in mind that the patient has, in most cases, only to be tided over a certain period of depression before reaction naturally follows, so that it is important to economize vital power, and not to waste it by over-stimulation.

The injection of hot saline fluid (1 drachm of chloride of sodium to 1 pint of water) into a superficial vein, the rectum, or the subcutaneous tissues (submammary or gluteal for choice), has been employed with considerable success of recent years. The *modus operandi* of intravenous infusion is described at p. 273; the fluid should be introduced at a temperature between 105° and 110° F. Several pints may be injected to begin with, the exact amount being governed by the reaction of the patient. If after a few hours symptoms of depression again supervene, the injection should be repeated.

According to Crile, the most valuable remedy for shock is an intravenous injection of a solution of adrenalin (1 in 50,000 or 100,000 parts of normal saline solution), a few cubic centimetres being allowed to enter the circulation each minute. The clinical value of this proposal has not yet been ascertained. He also suggests* that when shock is anticipated, it is well to clothe the patient in a special close fitting pneumatic suit, which can be inflated when necessary by a bicycle pump. The effect of this is to produce an artificial peripheral resistance, which will assist in emptying the subcutaneous veins and determine a flow of blood to the heart. The pneumatic suit has been used in many clinical cases, and the reports are encouraging.

An important question is often raised as to the advisability of performing an operation during shock. As a general rule, it may

* Crile, 'Blood-pressure in Surgery,' p. 288. J. B. Lippincott Co., 1903.

be stated that operation should be deferred until reaction has come on, unless the presence of the injured organ, such as a badly crushed limb, is evidently prolonging the condition. Under these circumstances a hypodermic injection of morphia may improve the condition by relieving pain; otherwise the condition should be at once dealt with, and it will be often found that, as the patient passes under the influence of the anæsthetic, the pulse improves, and the state of shock disappears, the anæsthetic shielding the medullary centres from the painful afferent stimuli. In urgent cases, especially when due to an intraperitoneal lesion, where operation must be undertaken without delay, the use of a saline injection into the venous system prior to operation is often most advantageous.

Shock may to a large extent be *prevented* during operation by a careful attention to such details as keeping the patient well covered up and as warm as possible, by perhaps operating on a hot-water table, by minimizing hæmorrhage, and by rapidity and cleanness of execution. A hypodermic injection of strychnine, or a brandy and beef-tea enema, given just before the operation, is also useful; and it must be remembered that incomplete anæsthesia tends to increase the shock rather than to prevent its occurrence.

II. **Traumatic Fever.**—Traumatic fever is that which follows the receipt of an injury, whether simple or compound, or after an operation. Two main varieties are described:

(*a*) **Simple Traumatic Fever** occurs after subcutaneous injuries, such as sprains, contusions, fractures, etc., and after aseptic operation wounds or compound injuries. It is thus found in conditions where micro-organisms are absent, or, if present, are in such a state as to be practically impotent. The generally acknowledged cause is the absorption from the blood-clot or inflammatory exudation of some chemical substance (possibly the fibrin ferment), which has a pyrogenic effect upon the medullary centres. Probably the fever following aseptic operations is largely determined by the use of irritating antiseptics, which increase the exudation and may damage the tissues considerably; if mild antiseptics or sterilized salt solution are alone used to irrigate open aseptic wounds, this so-called 'reactionary fever' will be absent, unless other elements, such as retained serous discharge or accumulation of blood, are present. Occasionally fever is observed in cases where we have no grounds for supposing that absorption of fibrin ferment is taking place; it may then be due to some peripheral irritation, *e.g.*, a badly-fitting splint, and disappears immediately on the removal of the cause.

The symptoms are those of slight pyrexia, reaching 100° or 101° F. within twenty-four or forty-eight hours of the injury, with coated tongue, loss of appetite, etc., gradually passing off in three or four days. If thus limited, it is of no prognostic importance.

(*b*) **Symptomatic Traumatic Fever** is that caused either by the absorption of the products of putrefaction, resulting from the vital activity of organisms in discharges, blood-clot, or dead tissue; or from the

absorption of the toxins connected with a development of parasitic organisms in the wound or its surroundings; or from the supervention of some general infective disorder. All these different conditions have been dealt with elsewhere, and require no further notice.

III. **Traumatic Delirium.**—Although delirium is merely a symptom which is superadded to others in certain cases, it is occasionally of so pronounced a character as to demand special attention. Three forms are met with:

(a) The **Active Delirium** which accompanies severe injuries, particularly in plethoric, and often in previously healthy individuals, whose environment has been suddenly changed from that of everyday life to a sick-bed in a hospital ward. Septic contamination of the wound is usually present, and the delirious state is associated and runs a parallel course with the traumatic fever. It is not usually of a violent type, although the patient may be irrational and restless: he moves the injured part without any evident appreciation of the pain which, if conscious, he must suffer, but he is easily restrained by the exhibition of firmness and tact on the part of the attendant. The symptoms are most marked at night, and commence at the end of forty-eight hours, lasting, as a rule, for two or three days. There is a distaste for food, which, however, can be overcome by gentle persuasion.

Treatment.—Patients in this condition must never be left; the diet should be light, but nourishing; the bowels are thoroughly opened, and an icebag to the head may be useful. The wound should be freed from any septic accumulation.

(b) **Delirium of a Low Muttering Type** is met with in individuals of low vitality, exhausted by dissipation, drink, disease, or faulty hygienic surroundings. It is commonly associated with fever of an asthenic type, such as is seen towards the end of septic or infective diseases. The patient usually lies on his back, staring vacantly upwards, is incoherent, takes no notice of surrounding objects, and is observed to pick at the bedclothes and mutter to himself unintelligibly. There is often, in addition, an involuntary escape of urine or faeces. The mouth is generally open, the tongue dry, brown and cracked, and viscid mucus collects about the teeth (*sordes*).

The **Treatment** should be directed to careful nursing and feeding, as by that means alone can the patient be saved.

(c) **Nervous Traumatic Delirium** is observed in individuals who, previously of intemperate habits, have suffered some serious injury, such as a compound fracture. The violent symptoms do not set in till about the third day, but are usually preceded by some amount of sleeplessness and wandering at night, or the patient may have short snatches of sleep, from which he awakes semi-delirious. This gradually increases, and is followed by violent delirium of the worst type (*delirium tremens*), in which the patient is haunted by terrifying visions of reptiles, horrible insects, and the like, from which he tries in vain to escape. During this stage of excitement he is with

difficulty restrained from jumping out of bed; in many instanc these patients are remarkably cunning, and, managing to elude th vigilance of their attendants, will succeed in escaping from the roo by the door or window, and may inflict serious, and even fata injuries upon themselves or others. There is always a tremulo condition of the extremities and of the tongue, which is white an coated, whilst the bowels are obstinately confined. The pulse an temperature vary considerably, and the skin is often moist an clammy. The violent stage is always followed by profound ex haustion, in which the patient may gradually sink into a state of com and die. In the case of a fractured leg, the struggles of the patie will cause considerable displacement of the limb, and necessita constant attention to prevent further mischief. The limb shou never be fixed to the bed, but slung in a Salter's swing or immobiliz in plaster of Paris.

Treatment.—In cases where an attack of delirium tremens is co sidered imminent, either from the previous history of the patient, th tremulous state of his hands and tongue, or his sleeplessness, th best treatment to adopt is to support the strength by suitable foo and a medium dose of stimulant, combined with free purging and, need be, soporifics (chloral, bromide, paraldehyde, or morphia) under such a regimen the symptoms usually soon disappear. I the acute maniacal attacks the patient must be fully controlled an guarded, but with as little manifestation of restraint as possibl Nourishing food (possibly of a fluid type), with a certain amount o stimulant, should be administered during the quiet intervals, an sleep obtained by drugs, especially morphia hypodermically; quarter of a grain should be given at first, and more if necessar Free purging is of course essential.

CHAPTER X.

THE GENERAL TECHNIQUE OF MODERN SURGERY.

No one who has been brought up in the modern school of antiseptic or aseptic surgery can have any idea of the horrors that were perpetrated under the name of surgery by our ancestors. Anæsthesia was unknown, and perhaps this was an advantage rather than otherwise, as it limited the number and the scope of operations. Patients had to be forcibly restrained during the procedure: hæmostatic forceps were not in existence, and the operating theatre was not the quietly decorous spot that it now is, but rather resembled the shambles. The wards were a hotbed of surgical fever, and erysipelas, pyæmia, and other manifestations of pyogenic infection led to an appalling post-operative death-rate. Hospital gangrene, wound phagedena, and other affections now happily extinct, were common enough, and not unfrequently wards had to be entirely closed in order to limit the ravages of such diseases. The almost synchronous discovery of anæsthesia and antisepsis has transformed surgery, and from being an art dangerous, barbarous, and almost repulsive, it has been changed into a scientific procedure, beautiful in its details and beneficent in its results. In this connection the names of Simpson, who fought the battle of anæsthesia, of Spencer Wells, who popularized the use of hæmostatic forceps, and of Lister, who first applied to surgery the principles that were being taught by Pasteur as to the microbic origin of disease, will ever stand out as three of the greatest benefactors of the human race.

The **Antiseptic** plan of treating wounds, as originally introduced by Lord Lister, is an outcome of the germ theory of putrefaction. It has for its object the prevention of bacterial development in wounds by the use of *chemical agents*, some of which are true germicides, capable of destroying the bacteria, whilst others merely prevent or inhibit their growth. Innumerable methods of applying this treatment have been adopted, and the plans originally suggested have been much modified in the direction of simplicity. Amongst the multifarious antiseptic agents which have been used, the most prominent are carbolic acid, corrosive sublimate, biniodide of mercury, iodine, iodoform, formalin, boric acid, salicylic acid, etc.

Carbolic Acid, the first antiseptic introduced by Lister, has a direct germicidal action in strong solutions, and an inhibitory effect in weaker ones. The crystals,

when heated with 10 per cent. of water, constitute an oily fluid known as pure or liquefied carbolic acid, which is a powerful though superficial caustic, and may be applied without much fear to infected living tissues—*e.g.*, to tuberculous sinuses or wounds—after scraping them, in order to destroy any portions of tuberculous material which may have escaped the spoon. Excess of the acid may be washed away with absolute alcohol, which quickly dissolves it. The liquid carbolic dissolves in water on the application of warmth, and the 1 in 20 and 1 in 40 solutions are those mainly employed; the former is an efficient and potent antiseptic, but must be used carefully on delicate skins. It is most important to insure the complete solution of the acid, as otherwise globules of it may be deposited on the hands or in the wound, and may do much harm. Carbolic acid is frequently somewhat crude and impure, and many of the irritative and toxic phenomena are due to cresylic acid and other substances which should not be present. General absorption of this reagent leads to darkening of the urine, which may become olive-green or even black in colour, and this carboluria is often associated with a rise in temperature and some intestinal irritation, whilst diseased kidneys may be seriously affected. Weaker solutions are more readily absorbed than the liquefied or pure acid.

Corrosive Sublimate is a valuable though very poisonous remedy, which is usually employed in solutions of 1 in 2,000, 1 in 1,000, or 1 in 500. Occasionally the last of these three solutions has 5 per cent. of carbolic acid added to it, constituting what is known as Lister's *strong mixture*. Sublimate solutions are inhibitory in action rather than germicidal, but are potent and reliable. They have less power of penetration than carbolic acid, and have less hardening or roughening influence on the skin. If, however, a dressing soaked in a sublimate solution (1 in 2,000) is kept for long in contact with the skin, it acts as a direct irritant, and may lead to an abundant formation of pustules, owing to the activity of the germs in the deeper parts of the cutis which have not been destroyed by the antiseptic. Instruments should not be placed in sublimate solutions, as, even if plated, they soon lose their bright appearance. It must be remembered that individuals very sensitive to the action of mercury may be salivated by this agent

Biniodide of Mercury is a potent antiseptic, which has been chiefly employed in the form of a 1 in 500 solution in 70 per cent. methylated spirit for the purification of the hands or of the skin of the patient. It is, of course, extremely toxic. A 1 in 2,000 aqueous solution is also employed for the hands, and is less harmful to instruments than the perchloride.

Boric or **Boracic Acid** is a mild and weak antiseptic, which may be utilized when stronger remedies might prove harmful—*e.g.*, in plastic operations and for infants. It is also useful when antiseptic fomentations are required in treating inflammatory phenomena.

Iodoform is a yellow powder of characteristic and unpleasant odour, which probably acts by being decomposed in the tissues and slowly giving off iodine. Commercial iodoform is usually contaminated with a variety of germs, as may be shown by dusting it over a film of nutrient gelatine and allowing them to develop. It is therefore wise to wash the iodoform before use in 1 in 20 carbolic lotion or some such antiseptic. Its chief value is in septic or tuberculous wounds, and, indeed, it seems to have a specific inhibitory action upon the development of the *B. tuberculosis*. It may be suspended in glycerine (10 per cent.), and after sterilization by heat this can be injected into tuberculous tissues, joints, or abscesses; or if open wounds exist, gauze soaked in this emulsion, as it is incorrectly termed, may be packed into them with advantage. Toxic effects of very variable type may follow from undue absorption of the drug. Gastro-intestinal disturbances, vomiting, diarrhœa, colic, etc., may be the chief symptoms, but delirium and collapse often supervene. There is always an abundance of iodine in the urine Various substitutes have been proposed in order to avoid the unpleasant smell—*e.g.*, aristol, orthoform, etc.—but they are of doubtful value. Perhaps the best means of obviating the odour is to mix with it $\frac{1}{10}$ part of Coumarin, the active principle of the Tonquin bean, which has a powerful aroma.

Chinosol is a yellow substance, harmless and free from toxic qualities it is freely soluble in water, and possesses powerful antiseptic properties.

Lysol is another useful antiseptic derivative of coal-tar. It is freely soluble in water, and as a 2 per cent solution may be used in syringing out cavities, such as the vagina, external ear, etc. One of its great advantages is that the solution is somewhat sticky, and tends to cling to the tissues and prolong its action.

Permanganate of Potash, Sanitas, and **Peroxide of Hydrogen**, all act in the same way as oxidizing agents; they are necessarily unstable and cannot be utilized for dressings, and are therefore chiefly employed in the disinfection of cavities or wounds already contaminated. The most potent of these is peroxide of hydrogen, which is sold as a fluid capable of setting free 10 to 20 times its volume of nascent oxygen. It is quite unirritating, and may be poured directly into a septic wound, or even into the peritoneal cavity; forthwith it commences to effervesce, liberating its oxygen, and forming a frothy foam, which is likely to bring to the surface any loose foreign bodies. Its use is particularly indicated in the treatment of septic ulcers, carbuncles, sloughy abscess cavities, and the like. Sanitas and permanganate of potash are used in solutions of varying strength, and act more slowly; the latter has the disadvantage of staining the tissues with which it is brought in contact.

Formalin is a powerful antiseptic, and consists of a 40 per cent. aqueous solution of formic aldehyde. It is decidedly toxic, even in a 1 per cent. solution. It blackens steel instruments, and hardens the skin to an unpleasant degree.

The **Aseptic Method** of treating wounds consists in the elimination of chemical antiseptics as far as possible, and the substitution of heat, dry or moist, as a sterilizing agent. Every efficient antiseptic is more or less toxic and irritating, and there can be no question that, from an ideal standpoint, the less they are introduced into wounds, the better. No more satisfactory germicide can be imagined than heat, in the shape either of boiling water or of steam under pressure, and it is claimed that if everything brought in contact with the wound is aseptic, then no antiseptics need be employed. Of course, there are two elements in an operation which can never be sterilized apart from chemical antiseptics—viz., the skin of the patient and the surgeon's and assistants' hands—and thus the most complete aseptic precautions can never entirely eliminate chemical agents. Moreover, it must not be forgotten that the air itself holds numberless germs which cannot be excluded from the wound, and that such germs are more numerous in crowded cities and in places where sick people are likely to congregate. To obviate this, most elaborate precautions have been taken in the shape of filtering the air admitted to the operating theatre, and also as to the cleanliness and dress of the surgeon and his assistants. For these it is strictly logical that the whole head should be enswathed in a sterile cloth with the exception of the eyes, since the scurf of the hair is septic, and the saliva is similarly contaminated, and it is impossible to move the head without detaching fragments of the former, or to speak without ejecting minute drops of the latter. Unsterilized persons, and therefore students, should be banished from the operating theatre, or placed behind a glass screen, as every additional onlooker must increase the risk in purely aseptic conditions. Then, too, the surgeon must be able to rely on assistants and nurses who are not changing

every six or twelve months. Hence, in a large teaching hospital, devoted to the training of students and nurses (and such, we believe, can only be effectively carried out by their active participation in the work), it is almost impossible to maintain a purely aseptic clinique. Whilst we have adopted many of the methods suggested by those who are able to insure complete aseptic precautions, we still cling to not a few of the measures originally introduced by Lord Lister, and which we have found, both in his hands and in our own work, give such excellent results.

The *actual details of operative technique* vary somewhat with different surgeons, but the main principles which govern modern operative surgery are much the same in all, and the following sketch of the preparations required and of the routine usually practised in undertaking an operation may be considered more or less typical of modern methods.

1. **The Operating Theatre or Room.**—The arrangement of this necessarily depends upon considerations of space and finance, and the ideals of the modern aseptic surgeon are seldom attainable. Thus, strictly speaking, no septic case should ever be dealt with in an aseptic theatre; no one should enter it without first bathing and donning an aseptic garb; the air should be thoroughly filtered before its admission, and all unnecessary sightseers kept away.

For practical purposes, however, much less rigid precautions have to suffice. The operating theatre should not be unnecessarily large, and the old-fashioned room with tiers of seats overlooking the central area is not desirable. Onlookers should have a low gallery provided for them, but little raised above the floor-space and shut off from it not merely by a rail, but by an effective closed barrier breast high. It may with advantage be placed between the operating area and the source of light, but clear of the window, and should be entered by a separate passage and not through the theatre. A north light is desirable, and it should come, not from the top, but from the side, in the form of what is known as a 'studio light.' The walls should be lined with white tiles, glazed bricks, marble or alabaster, or at least painted with white enamel, which can be washed down with a hose. The floor must be impermeable, and slope towards a circular aperture or drain, discharging over an open head through the outside wall, so as to allow of suitable flushing with a hose. All shelves must be made of glass, but the fewer fixtures in the actual theatre the better. Attached to the theatre should be a suitable series of smaller rooms for the anæsthetist, for sterilizing purposes, etc.

In a private house the room should, if possible, be carefully prepared beforehand. The carpet should be taken up and curtains removed. The walls should be wiped over with an antiseptic solution, and the floor thoroughly scrubbed; all unnecessary furniture is removed. Should the operation be an emergency one, without time for such complete preparation, it is often wiser to leave things alone, and not stir up dust and dirt by a hurried attempt to make things look a little better than they really are. A suitable supply of hot

and cold boiled water must be secured beforehand, and basins and dishes, etc., should, if possible, be previously boiled.

2. The **Surgeon and his Assistants** must remember the extremely grave responsibility that rests upon them in undertaking many of the modern operations, and must be willing and ready to submit themselves to the strictest régime. The coat must be removed, and the sleeves of the shirt and vest turned well up above the elbows, and retained there, if need be, by safety-pins or suitable clutches. A mackintosh apron may then be donned, and over it a sterilized cloth apron, wet or dry. We do not consider that it is necessary to wear a head cover, although ideally this should be the case, especially when the individual is hairy; if, however, he is suffering from a nasal catarrh, the mouth and nose should certainly be covered with a damp cloth. Unnecessary talking during the operation is forbidden, and, whenever possible, directions should be given by signs. If it is necessary to cough or sneeze, the head must be turned aside completely. The antiseptic habit must be so ingrained as to become automatic, and it should be impossible for a surgeon to take a handkerchief from his pocket and blow his nose or wipe perspiration from his brow, and then resume the operation, without effective re-sterilization of the hands. Those who have the misfortune to perspire easily must be most careful not to allow drops of sweat to fall into or near the wound.

The same rules hold good in regard to the *nurses*, who should also turn up their sleeves above the elbows. The hair should be arranged quietly under a cap, and a fringe avoided. Long tails to caps are out of place in the operating room.

Much of the success of an operative clinique depends upon the methodical and effective organization of the same. It is desirable that all unnecessary hands should be eliminated, and therefore everything likely to be needed should be laid out within reach of the surgeon and his assistant on a suitable side-table, so that they may be able to take up instruments, ligatures, sutures, etc., without being touched by others.

3. The **hands** are scrubbed thoroughly with soft or ether soap and hot water (preferably sterilized); the nails are cut, if need be, and cleansed, special attention being directed to the semilunar folds of skin at the base, where septic material is so apt to collect. For this purpose a purified nail-brush is employed with advantage. The hands are then immersed in an efficient antiseptic lotion—*e.g.*, a 1 in 500 solution of biniodide of mercury in 70 per cent. methylated spirit for one minute, and then in 1 in 40 carbolic or 1 in 2,000 sublimate solution. The hands, once purified, should not be dried except on a sterilized towel; indeed, it is better to keep them moist and redip them from time to time during the operation either in the 1 in 40 carbolic or 1 in 2,000 biniodide of mercury or sublimate solution, and in intraperitoneal work in sterilized salt solution (℥i. to 1 pint). Another plan consists in immersing the hands and forearms in a saturated solution of permanganate of potash, after thorough washing

with soft soap and water, until they become a deep mahogany-red colour. They are then placed in a warm saturated solution of oxalic acid until completely decolourized, and are finally washed over with sublimate solution. This method is apt to cause a certain amount of irritation of the skin of the forearms. It is possible that in many instances complete sterilization of the hands is not effected, but the surgeon must always keep complete asepsis of his hands before him as an ideal to be attained. On several occasions when our hands and those of our assistants were tested bacteriologically after the use of the biniodide of mercury and sublimate solutions, they were found to be sterile, even scrapings from beneath the nails giving no reaction. Some authorities have been so concerned at the imperfection of their results that they are in the habit of operating in sterilized cotton gloves, frequently changed during a lengthy operation, or in thin rubber gloves, which can be sterilized by boiling. We are extremely doubtful as to the value of this plan, and feel that a certain degree of delicacy of touch must be sacrificed thereby. Careful attention to the skin after operations—*e.g.*, the application of glycerine at night, so as to prevent it becoming rough and harsh—is a most important element in success.

4. **Instruments** are sterilized by boiling them in a weak solution of bicarbonate of soda (1 per cent.) for five or ten minutes. To prevent them from rusting, they should be carefully plated, and the water ought to boil for some minutes before they are immersed, in order that the suspended air may be driven off. After boiling they may be laid out on a sterilized dry towel and covered over with a similar towel till they are required, or kept in a weak antiseptic solution (*e.g.*, carbolic lotion, 1 in 60). Mercurial solutions should be avoided, as they spoil the instruments. If during an operation an instrument which has not been previously sterilized is required, it may be quickly purified by immersing it for half a minute in liquefied carbolic acid, the excess of which is removed by washing thoroughly in alcohol or hot sterilized water. The same process or re-boiling must be adopted for any instrument which falls on the floor or becomes otherwise soiled. Special care must be directed towards the forceps to see that the serrations are freed from dried blood-clot and other dirt. Hæmostatic forceps must be opened before boiling.

5. **Sponges**, unless very carefully treated, are a fertile source of mischief, but their power of absorbing blood and other fluids is so much superior to that of any other agents that many surgeons still retain their use. They should be thoroughly purified in 1 in 2 carbolic lotion before use, and wrung out of a 1 in 40 solution of carbolic or a 1 in 2,000 sublimate or biniodide of mercury solution during the operation. Only a limited number of sponges—say, two or three—is used, and the assistant cleanses them in a bowl of lotion placed in a suitable position. Sponges should never be used for tuberculous disease or rectal operations, or for any conditions where pus is present, or if so used, they should be subsequently destroyed.

In cleansing sponges after an operation, the following proceed-

ecommended: They are first thoroughly wrung out of cold
ıd then placed to soak for a few minutes in a hot and strong
of washing soda. They are then well rinsed in hot or cold
· kept in running water, so as to remove all the soda, and
ımersed in a solution of carbolic acid (1 in 20), in which
kept till required.

bs are used instead of sponges, they are made of absorbent
ıpped up in a single layer of gauze, the ends of which are
ıp into a knot. A sufficiency of these of a suitable size is
before the operation, and they are purified in a dressing
. They are kept in the drum or box in which they were
until required, and are thence removed by sterile hands or
nts to a suitable sterile receptacle, or are placed in lotion.

e **ligatures** and **sutures**, whether of catgut or silk, require
rough purification. Silk needs to be boiled thoroughly for
ıalf an hour, and is then placed in carbolic lotion (1 in 20);
l be in loose coils, and not wound on a reel, as then only
ıide strands are sterilized. Catgut, on the other hand,
ıt be boiled in water or immersed in carbolic lotion for
, as it is apt to become rotten and break when used. It
wever, be boiled in cumol at a temperature of 165° C. for an
hout harming it; it is then dried at a temperature of 100° C.
air oven for two hours, and is transferred to sterilized test-
Mayo Robson has advised the sterilization of catgut in
hich is kept at the temperature of boiling water for half an
\ special metal cylinder with a screw top is required. The
s loosely wound on a reel or slide, and sufficient xylol is
ı the cylinder to cover the catgut; the top is then screwed
ıd the cylinder is placed in a saucepan of cold water, which
ıally brought to the boil, and allowed to remain boiling for
ıour. The catgut is then removed, and kept in a 5 per cent.
solution in alcohol. Another simple and effective method
ce the catgut wound loosely on a glass reel firstly in ether
ıty-four hours, and then in a 5 per cent. solution of formalin
ımilar period; it is then immersed in boiling water for five
, and subsequently kept in a solution of corrosive sublimate,
glycerine, 250 parts; and methylated spirit, 1,000 parts.
instrument-makers provide sterilized catgut in sealed glass
Van Horn's catgut and suture materials can usually be
hly trusted.

ıe **skin of the patient** is shaved prior to operation if the part
, and thoroughly washed with turpentine, soft soap and
ilized water, and some efficient antiseptic; it is then covered
antiseptic compress—*e.g.*, gauze or lint soaked in carbolic
ı in 40) for some hours. When the patient is on the table
æsthetized, a final cleansing is undertaken. The part is
ll rubbed over with turpentine or ether to remove all fat and
and then washed again with soft or ether soap and hot sub-
lotion (1 in 2,000). It is then flushed with biniodide of

mercury in spirit (1 in 500) or with carbolic lotion (1 in 20), and finally the stronger antiseptic is washed away with a weaker solution either of carbolic acid or sublimate. It must not be forgotten that a very vigorous use of carbolic acid may be followed by local irritation, as well as by its absorption into the blood-stream, especially in protracted operations. Care must also be taken that the patient does not lie in a pool of antiseptic lotion which has run down during the washing and collected under the sacrum; many a bad antiseptic burn has resulted therefrom. Again, not only does the quality of the skin vary in different individuals (as may be illustrated by contrasting that of a coal-heaver, who possibly bathes once a year, with that of a child or lady, which is soft, clean, and delicate), but it also differs in various regions of the body, and hence the process of purification must be modified according to the character and thickness of the integument. Any part where dirt may accumulate demands scrupulous attention—*e.g.*, the umbilicus, external ear, toes, or corona glandis in persons with long foreskins. A word of warning is also needed as to the possibility of using a nail-brush too vigorously, leading to a traumatic dermatitis, or even waking up into activity germs which otherwise would have lain dormant in the deeper layers of the uninjured skin.

8. The **area of operation** is surrounded by mackintoshes, which should always be treated as more or less septic, and these in turn are covered with sterilized towels. The latter are by choice purified by boiling or by exposure to steam in a suitable sterilizer; but if desired they may be first soaked in a solution of carbolic acid (1 in 20), and then wrung out of a hot 1 in 40 solution, and kept warm until required. The objection to this latter plan is that the skin may be burnt if the patient has to lie on such a towel. Some surgeons prefer to use dry sterilized towels, but to our minds the wet are better, in that they cling closer to the skin and are less liable to slip. During an operation irrigation or flushing is unnecessary, unless the proceedings are prolonged, and then hot sterilized salt solution should be employed for the purpose; but a final flushing with carbolic lotion (in in 40) or with sublimate (1 in 2,000) is advisable, especially when operating under conditions which are not ideal as to surroundings and technique. The objection to such flushing is that the lotion is more or less of an irritant, and determines a certain amount of subsequent oozing and effusion, which will necessitate drainage. More particularly, when dealing with the peritoneal cavity or interior of a joint, the less one employs antiseptics the better; they lead to desquamation of the delicate endothelial lining which it is so important to maintain intact. In fact, the rule of practice which we now insist on is *the strictest antisepsis for the external parts, but asepsis for the interior of the wound.* One cannot, however, always be certain that this ideal has been attained, and then irrigation with an antiseptic solution may be desirable.

9. Before closing the wound the surgeon must use every endeavour to secure absolute **hæmostasis**, and then the wound may usually be

stitched up completely and without drainage. In large wounds of vascular parts, and especially when some amount of oozing may be expected, it is advisable to insert a suitable drainage-tube, and stitch it flush with the surface. It is removed at the end of forty-eight hours at most. We feel confident that the removal of the discharge and the changing of the soaked and perhaps stiffened dressings add materially to the comfort of the patient.

When the operation has been thus completed, the skin around is again cleansed with lotion, but *only after a piece of dressing has been placed as a protection over the wound.* This cleansing should always be accomplished by wiping peripherally away from the centre, and any sponge or swab which has been utilized for this purpose should not again be allowed to touch the wound.

Wounds communicating with septic cavities, such as the mouth or rectum, should be purified with a solution of chloride of zinc (5 grains to the ounce), and then powdered with iodoform, and either left open or lightly packed. Septic contamination is by this means delayed; and even when it does occur, it may be kept under control by frequent dressing and irrigation.

6. Finally, a carefully arranged **Dressing** is applied, and the part bandaged and placed at rest on a splint or in a sling, if such is indicated by the requirements of the case; absolute rest and quiet are essential if rapid healing is to be obtained.

As to the different forms of dressing, we must content ourselves with a few words as to those ordinarily employed. Lord Lister pointed out some years back that the main essentials of a good dressing consisted in its containing some trustworthy antiseptic ingredient; in this agent being so stored up that it cannot be dissipated before the next dressing; in its being entirely unirritating; and in the capacity of the fabric to readily absorb blood or serum that may ooze from the wound. The original antiseptic dressings, viz., the carbolic and eucalyptus gauzes, and even the alembroth gauze and wool, failed to fulfil these requirements; but in the double cyanide of mercury and zinc gauze we have a material which is to all intents and purposes perfect. It should be soaked for some hours in a similar lotion (1 in 20), and may be applied to the wound without fear after wringing it out of a 1 in 40 solution. A sufficiency of this is employed so as to cover in a good margin of skin all round the wound, and, finally, over all a liberal covering of sterilized or antiseptic wool, so as to diffuse the pressure, which is applied by means of careful bandaging. The best material for bandages is butter-cloth, since it is light and adapts itself easily to the outlines of the part. Other dressings, such as boric lint, iodoform gauze, etc., are occasionally employed, but they are not so satisfactory for general use as the cyanide gauze.

Many surgeons employ simple sterilized gauze without any antiseptic ingredients, and where complete asepsis has been maintained and no subsequent discharge comes through, this will suffice admirably. We cannot, however, but feel that an antiseptic dressing is an extra

precaution that may be wisely adopted, and especially in cases where much discharge is expected. We would draw attention here to the fallacy of using sterilized cyanide gauze without soaking it in carbolic lotion; the object of the latter is largely to get rid of a certain quantity of irritating antiseptic which remains loose in the fabric, and unless washed out may give rise to an eczema of a very irritating character.

11. **After-treatment.**—If no drainage-tube has been employed, and the dressing is not soaked through, it may be left untouched for seven or eight days, at the conclusion of which period it is removed, the stitches are taken out, and in all probability the wound will be completely healed. When a drainage-tube has been inserted, it is usual to take it out at the end of twenty-four or forty-eight hours; there is no advantage in retaining it longer, since it is only required for the removal of the sero-sanguineous fluid which exudes immediately after the operation. Should the discharge be very abundant and soak through the dressings, there is no need to remove them and re-dress during the first twenty-four hours, if the cyanide gauze has been employed; all that should be done is to damp the stained external bandages with 1 in 20 carbolic lotion, and then pack on some more gauze or wool. This may even, if necessary, be repeated a second time.

12. The **after-dressings** of the wound need to be conducted with the same precautions as to asepsis of hands, instruments, etc., as the original operation, and not a few instances of infection at the first dressing occur. It is essential that everything likely to be required should be prepared before the dressings are removed, so that exposure to the air may last as short a time as possible. If the first dressing is undertaken after twenty-four or forty-eight hours, and all is going on satisfactorily, the tube is removed, and the wound redressed in exactly the same way as formerly, though probably much less dressing will be required. If the case is left for eight days, the stitches can probably be taken out, and the surface will then be found united. A small dressing of cyanide gauze is applied, fitting closely to the scar, and sealed down with flexile collodion, which will not only prevent the gauze from slipping, but will also by its contraction serve to steady the parts. This may advisably be kept on for another week.

CHAPTER XI.

HÆMORRHAGE.

By the term *hæmorrhage* is meant any loss of blood, whether insignificant and immediately arrested by natural means, or more excessive and requiring treatment to prevent its continuance. Although most commonly due to some injury, whether subcutaneous or inflicted through the skin, it may be predisposed to by weakness of the vascular tissues, especially if associated with increased blood-pressure. Certain diseases, such as purpura and scurvy, are characterized by a tendency to bleeding, and there is one congenital condition, hæmophilia, in which it is difficult to stop the flow of blood when once started.

The **character** of the bleeding differs according to the vessel from which the blood escapes. **Arterial Hæmorrhage** consists in a flow of bright scarlet blood, which escapes at first *per saltum*, *i.e.*, in jets synchronous with the heart's beat, and may be derived, not only from the proximal, but also from the distal end of the divided vessel, if the collateral circulation is sufficiently abundant. If, however, it is derived from a deep artery, the blood may well up from the depths of the wound and not escape in gushes. In **Venous Hæmorrhage** the flow is usually continuous, and the blood of a dark red or almost black colour. If, however, a large vein is wounded, such as the internal jugular, the blood may escape with a very definite spurt, owing to respiratory or other influences. **Capillary Hæmorrhage** is marked by general oozing from a raw surface, the blood trickling down into the wound, and filling it from below upwards. By **Extravasation of Blood** is meant the pouring out of blood from a wounded vessel or vessels into the lax areolar planes immediately adjacent, which become swollen and boggy. The usual constitutional signs will be manifested as a result of such extravasation, and, indeed, fatal hæmorrhage may occur in this way without any escape upon the surface of the body. Subcutaneous or submucous hæmorrhage is also met with in the form of small localized **petechiæ**, arising from injuries, or from changes in the blood or vessel walls (as in purpura, scurvy, and septicæmia). **Epistaxis** is the term given to bleeding from the nose. By **Hæmatemesis** is meant the vomiting of blood; it may either have been swallowed, as in some cases of

fractured base of the skull, where the pharyngeal mucous membrane has been torn, or it may have originated from the upper part of the intestinal tract. The blood is usually curdled and brownish in colour, somewhat resembling coffee-grounds, from the action of the gastric juice upon it. **Hæmoptysis** is the title given to the escape of blood from the air-passages, whether it results from injury or disease. **Hæmaturia** is a condition in which blood is passed in the urine. By **Melæna** is meant the passage of dark tarry blood with the fæces; it is always an evidence of disease or injury of the intestine sufficiently far from the anus to allow the blood to become altered in character by the action of the intestinal juices. Blood derived from the rectal mucous membrane usually retains its bright red colour.

Constitutional Effects. — If the hæmorrhage is severe, as from division of a large artery, death results from syncope. The surface of the body becomes cold, clammy, and pale; the lips, ears, and eyelids are livid; the patient gasps, his respirations become quick and sighing, and death ensues after perhaps a few convulsive twitches of the limbs. If consciousness is retained at all, patients often complain of the sight failing, and a sense of increasing darkness, immediately preceding the fatal termination. These effects depend as much on the rapidity of the bleeding as on the total amount of blood lost; people can stand gradual loss of blood much better than when it escapes suddenly.

If the hæmorrhage is not so great as to kill immediately, the patient faints, and on recovering is in a condition of severe collapse and weakness, which continues for some time; he is also liable to recurrent attacks of syncope, any one of which may be fatal.

If the hæmorrhage is more gradual, but continuous, as in cases of piles or uterine fibroids, the patient becomes profoundly anæmic, and the lips, ears, and conjunctivæ are pearly white; dyspnœa ensues, owing to the insufficient amount of blood present, and in consequence the patient is extremely restless, tossing about in bed. Any sudden exertion, or even sometimes the attempt to sit up, is followed by a sensation of faintness; noises are heard in the ears, the sight becomes dim, or is even temporarily lost (amblyopia), and severe headache may be complained of, all arising from cerebral anæmia. The pulse often becomes what is known as *hæmorrhagic* in character, *i.e.*, frequent, large, and compressible, but collapsing entirely between each beat, and markedly dicrotic. These peculiar features are due to the sudden passage of a small amount of blood through a vessel which is practically empty and entirely collapsed. From the defective *vis-a-tergo*, œdema of the extremities may result.

During the continuance of hæmorrhage the blood-pressure necessarily falls; but unless a volume equal to a third of the total bulk of blood in the body is lost, it quickly rises again to the normal after the bleeding has ceased. This rise in blood-pressure is partly due to a diminution in the size of the vascular area, owing to vasomotor contraction of the peripheral arterioles and of the splanchnic area, but is also caused by an increased flow of lymph into the circulation.

0·6 per cent.), at a temperature of 105° to 110° F. The dried cry of salt should be dissolved in a small quantity of boiling wat as to sterilize it, and this is then diluted to the required bulk. course, the apparatus is most scrupulously purified, either by b for some minutes or by effective immersion in carbolic lotion, no air must be admitted. The injection is made slowly, so tha solution may be gradually mixed with the blood. It has been f by experiment that after an infusion following hæmorrhage specific gravity of the blood is only lowered for a very short p

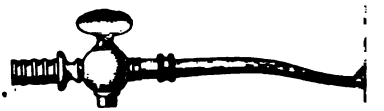


FIG. 72.—CANNULA SUITABLE FO INFUSION.

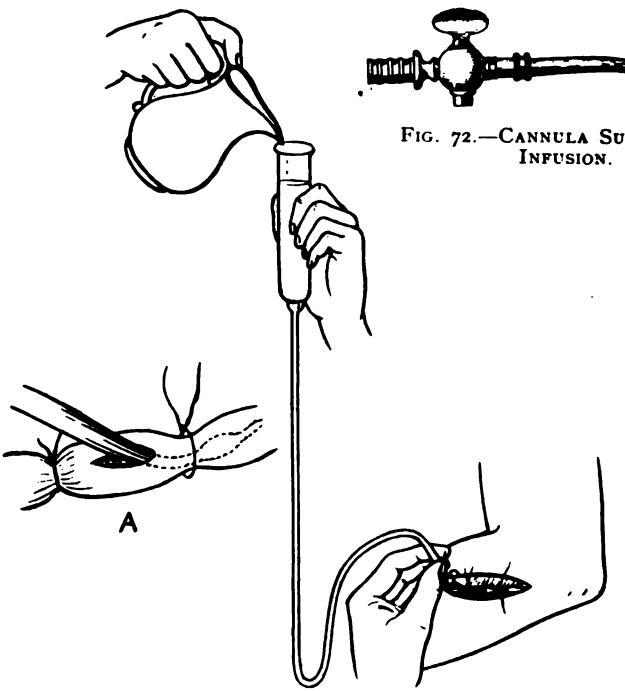


FIG. 73.—INFUSION INTO VEIN OF FOREARM.
At A the arrangement of the ligatures around the vein is indicated.

and rapidly rises to a normal level, or may even be raised abo normal. This suggests that the increased amount of fluid is s up by the tissues, and explains why it is sometimes necess repeat the injection more than once.

Another plan sometimes used with success consists in the duction of warm fluid into the rectum, or through an aspirator connected with a tube and funnel into the loose connective tis the buttock, abdomen, or submammary region (*hypodermoclysis*) the latter case the funnel must be held at some height (5 or 6 f

rder to gain sufficient pressure, and by this means a pint or more ay be injected: a carefully sterilized syringe and a large needle ay be employed for the same purpose. During the injection the rt should be gently rubbed so as to distribute the fluid.

Natural Arrest of Hæmorrhage.

This can best be described under two headings, viz., (1) the mporary arrest, and (2) the permanent. The processes are much e same for arteries, veins, or capillaries; but since the arrest of terial hæmorrhage has been more thoroughly investigated, and is e most important, we shall deal mainly with it.

The **Temporary** arrest of arterial hæmorrhage is brought about by ee principal factors:

1) The **coagulation of the blood**, which occurs in and around the ssel, and without which death would ensue from the merest scratch. he greater the loss, up to half of the total amount of blood in the dy, the more coagulable it becomes.

2) **Diminution in the force of the heart's action** always follows emorrhage, from anæmia of the cerebral centres, a beneficent ovision whereby coagulation is facilitated and the flow of blood ecked. Unless the syncope is profound, stimulants should therefore be carefully avoided until the vessel has been efficiently aled, for fear of causing a recurrence of the bleeding by increasing e power of the heart's beat.

3) **Changes in and around the vessel** play a most important part completing the process. They consist in the **retraction** of the ssel within its sheath by reason of its inherent longitudinal elasticity; if, however, it is only partially divided (or, as it is called, 'button-holed'), this condition cannot obtain, and the hæmorrhage is ore likely to continue. As a result of this retraction, the rough d uneven inner lining of the sheath is exposed, and upon this the ood coagulates as it flows, thus gradually producing what is known the **external coagulum**. At the same time the transverse muscular d elastic fibres in the vessel wall cause **contraction** of the open uth, and thus, as the force and calibre of the blood-stream minish, the external coagulum is able to increase in size by fresh posits of fibrin, until at last its resistance is too great for the minished cardiac impulse to overcome, and the sheath is filled with t, which extends to the divided mouth of the vessel. From this **internal** coagulum next develops, which sometimes extends upwards as far as the nearest patent branch. Thus the hæmorrhage is ested for the time being, and preparation made for

The **Permanent** closure of the wound in the artery, which merely sists in a modification of the general process of repair.

fter the cessation of the hæmorrhage, the internal coagulum, soft nsistence and dark red in colour, extends from the mouth of the el, or from the site of the ligature, for some distance, and perhaps e next collateral branch (Fig. 74). The vessel wall contracts

upon this coagulum, with which, however, it does not unite, e at and near its base. As a result of the injury, a simple p arteritis is set up, evidenced by a hyperæmic condition of the wall, due to dilatation of the vasa vasorum, and its infiltratio leucocytes, which also invade the coagulum and cause its b become decolourized. The leucocytes break up the clot, trav the natural lines of cleavage which result from its contractio gradually remove it, a few giant cells, probably derived fro leucocytes, occasionally assisting in this process (Fig. 77). tunica intima proliferates concurrently, causing a secondary in tion with the larger fibroblastic cells in that part of the thro which is adherent to the vessel wall (Fig. 76); whilst a grow cellular buds or granulations, which gradually increase in siz encroach on the lumen of the vessel, springs up in those parts

FIG. 74.—EARLY STAGE OF OBLITERATION OF ARTERY AFTER LIGATURE.

The thrombus is seen above and below the site of ligature, that on the proximal (upper) side being the larger; commencing cell infiltration of the bases of the clots is also indicated.

FIG. 75.—LATER STAGES OF T SAME PROCESS.

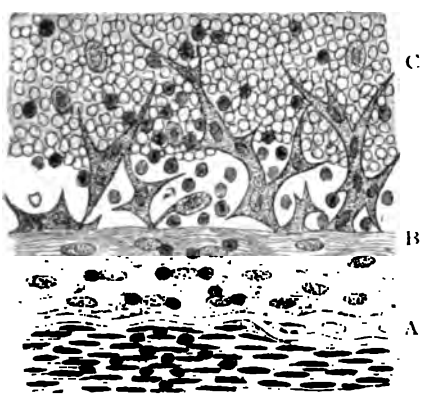
The clots are shrinking, and the l portions are being transform granulation tissue. Prolifera the tunica intima is also seen, ing beyond the apices of the cl

In both these diagrams the arteries have been represented of the sam throughout for clearness' sake; in reality, the lumen would be muc tracted.

the apex of the clot lies free and unadherent (Fig. 75). Thu base of the clot is transformed into a cellular mass derived proliferation of the tunica intima, and by the development of vessels from the vasa vasorum into granulation tissue; whil cellular buds which grow from the walls, and extend nearly t next collateral branch, are also similarly changed. The free co extremity of the clot contracts, and is gradually removed, part the activity of leucocytes which infiltrate it from the base, part the erosive action of the surrounding granulation tissue. A s set of changes occurs at the distal side of the ligature in an arte in its continuity, although the thrombus is smaller and less firm. ligature itself may be infiltrated by leucocytes, and replaced by g lation tissue, or may be encapsuled. A rod of granulation tis

ıs developed, blocking the vessel, and this, by the usual process of pair, is transformed into a firm cicatricial cord in the course of a w months (Fig. 77). It must be clearly understood, however, that e presence of a coagulum is by no means essential to the obliteration an artery. Thus, if the walls are merely brought into close and curate apposition by a ligature without dividing the inner or middle ats, a proliferative endarteritis without any clot formation results, hich is quite sufficient for the occlusion of the vessel.

The arrest of hæmorrhage from veins and capillaries is more easily ıplished, the collapse of the walls, together with the formation f the external coagulum, being sufficient for this purpose. The later teps are similar to those occurring in an artery, except that there is ıt little internal coagulum. In capillaries, unless some constitutional



ıg. 77. Early Stage of Organization of Thrombus, to show the Infiltration of the Clot with Leucocytes and Connective-Tissue Cells derived from the Endothelium. (Tillmanns.)

A, Tunica media; B, tunica intima, undergoing proliferative changes, and therefore thickened; C, blood-clot lying in lumen of vessel, becoming infiltrated with leucocytes (small dark cells) and larger fibroblasts derived from the endothelium.

ndition such as hæmophilia is present, the mere falling together of e walls is sufficient to allow coagulation to take place, and thus p the bleeding.

Surgical Treatment of Hæmorrhage.

Many different methods are needed, under varying circumstances, the effective arrest of hæmorrhage. It may be laid down as a iminary axiom that digital pressure over the bleeding-point will ys temporarily check the most furious outburst, whilst means for ermanent stoppage are being arranged.

Where the bleeding, though profuse, does not come from any one particular , the following measures can be utilized:

1. **Cold** may be employed in the form of ice, cold water or lotion, or simple exposure to the air, all clots, rags, pledgets, etc., being removed for this purpose; it must, however, be remembered that ice and unsterilized water may convey sepsis. Such treatment is of most value for general oozing from vascular structures or into cavities, such as the mouth, vagina, or rectum.

2. **Position.**—Where the bleeding is from one of the extremities, especially the lower, **elevation** is a most important factor in arresting it. The veins are emptied by the force of gravity, and this is always followed by a reflex contraction of the arteries, a proceeding of which surgeons avail themselves in order to exsanguinate a limb before applying a tourniquet in operations which one desires to render as bloodless as possible.

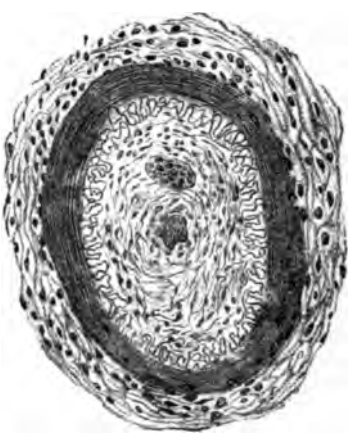


FIG. 77.—ORGANIZED THROMBUS IN VESSEL, SHOWING THE NEWLY-FORMED CONNECTIVE TISSUE OCCUPYING THE LUMEN OF THE VESSEL, AND VASCULARIZED FROM THE VASA VASORUM. (TILLMANNS.)

Two giant cells are seen in the centre.

3. **Direct Pressure.**—The skilful application of an antiseptic dressing, combined with pressure, is often effectual in arresting hæmorrhage. General oozing from cut surfaces, which can be brought into apposition, as from an amputation wound, may be checked by applying a firm bandage over them. In cavities or hollows, either natural or made by operation, bleeding may be stopped by plugging with strips of dressing, or by graduated layers of antiseptic wool. Such dressings should be retained firmly in position for twenty-four hours, after which, if no further hæmorrhage has occurred, the bandages may be slackened, but it is usually advisable to retain the deep plugs for another day.

4. **Hot Water** (130° to 160° F.) is a powerful hæmostatic. A certain proportion of carbolic acid or corrosive sublimate should be present to render the water aseptic, or it should have been previously

in exceptional circumstances. A needle is passed either under the vessel from the skin, or over the vessel from the surface of the wound, and, if placed accurately, is quite sufficient to stay the bleeding. With it, however, is sometimes combined the pressure of a loop of silk or wire passed figure-of-8 fashion around the ends of the needle.

2. **Forcipressure** is a plan of stopping hæmorrhage by crushing the divided end of the vessel between the strong and deeply serrated blades of a pair of forceps with scissor handles provided with a catch; those known by the name of Spencer Wells or Greig-Smith are the most convenient. In dealing with small vessels, it is quite sufficient to leave the forceps applied for a few minutes, perhaps twisting them before removal; but with the larger it is advisable to apply a ligature, although it is claimed for the Greig-Smith pattern that the artery is so thoroughly crushed that this is unnecessary. In deep wounds, where it is difficult, or almost impossible, to tie the vessel, the forceps may be incorporated in the dressings, and not removed for twenty-four hours.

3. **Torsion** was used as a means of sealing the ends of divided vessels before aseptic ligatures were introduced. It may be applied in two ways—viz., (*a*) **Limited Torsion**, which is employed for the larger vessels. The artery is drawn out of its sheath for about half an inch with one pair of forceps, and held close to the tissues by another pair applied transversely, whilst the grasped end is twisted sufficiently to thoroughly close it; it should not, however, be twisted off. (*b*) **Free Torsion** is used for the smaller vessels, which cannot be so completely isolated from surrounding structures; the vessel is laid hold of with its sheath or connective-tissue covering, and twisted as much as necessary.

The **effect** of torsion is that the inner and middle coats are ruptured just above the spot grasped, and tend to curl upwards into the lumen of the vessel, whilst the outer coat is twisted up beyond. A coagulum forms upon the injured structures, and the subsequent processes to secure permanent occlusion are similar to those described above. Torsion is employed occasionally in plastic work, and in twisting off small vessels previously secured by forcipressure forceps.

4. **Ligature** is at the present day the method most frequently used for arresting bleeding from a definite source.

The **material** should be of sufficient strength to secure the vessel, of sufficient resistance to maintain its hold in spite of being soaked in the body fluids, and yet of such quality as to be finally absorbed, or so pure and unirritating as to become encapsuled in the tissues. Catgut suitably prepared is the substance most frequently employed, but inasmuch as commercial catgut, even when rendered aseptic by immersion in carbolic acid, swells up in warm blood serum, and becomes a soft, pulpy mass in half an hour, it is necessary to harden and render it more resistant by steeping it in a solution of chromic acid, and subsequently in a sulphurous acid solution. It is then dried, and is of a greenish colour. It must not be forgotten that catgut is prepared from sheep's intestines, by allowing the latter to

then manifest themselves in due order. An exudation of plastic lymph and cells occurs into the sheath and around the ligature, and if the latter is aseptic, the whole is embedded in this plastic mass which undergoes the ordinary changes seen in repair. If the ligature however, is *septic* and irritating, it has to cut its way out through the vessel wall by an ulcerative process akin to the separation of a septic slough, thus exposing the patient to the risk of secondary hæmorrhage from the disintegration of the internal coagulum. The period at which a septic ligature is separated varies with the size of the vessel, from a week or eight days for an artery the size of the radial or ulnar to twelve or fourteen days for the subclavian or carotid.

Division of the inner and middle coats is not to be considered an essential element in gaining satisfactory occlusion of a vessel, for it can also be effectively accomplished by merely bringing the vascular tunics into close apposition with a broad animal ligature applied by what is known as a 'stay knot' (p. 327), without harming the tunica intima. This plan may be adopted advantageously (1) when the artery must be tied at a spot where it is obviously diseased; or (2) in dealing with arteries of great size, such as the innominate, the first part of the subclavian, or the common iliac; the non-observance of this precaution results in aneurismal dilatation at the point of ligature and this in secondary hæmorrhage and death. On the other hand, it would seem safer to apply a ligature firmly on the main trunk in an amputation stump, since the division and curling up of the inner and middle coats must facilitate the deposit of fibrin and process of repair.

All arteries in the body are maintained more or less upon the stretch, and hence retract within the sheath on complete division. A certain amount of longitudinal tension must therefore always exist upon any part of an artery to which a ligature has been applied in its continuity, and this may presumably predispose to secondary hæmorrhage. To obviate this, it has been suggested that two ligatures should be applied, and the vessel divided between them. This plan may be used with advantage in situations where the artery is easily accessible, but is scarcely feasible in some of the deeper operations.

2. The **Ligature** itself undergoes changes, which result in its partial or total absorption, if such be possible, or in its becoming encapsuled if absolutely unabsorbent. The leucocytes attack any soft material such as silk or catgut, insinuating themselves amongst the fibrils and finally remove them by a similar digestive process to that which leads to the absorption of a small aseptic slough. Multinucleated giant cells are often present, and probably take some part in the proceeding. Finally, every trace of the ligature disappears, and its place is taken by fibrous tissue, incorporated with that arising from the coat of the vessel. Chromicized gut, as already explained, lasts a variable time according to its method of preparation; silk is removed, but slowly. Other animal substances employed are dealt with in the same way, and even silver wire is not unaffected, its surface becoming roughened after a time and slightly eroded.

3. The effect on the **Circulation** is the same whether ligature or any other plan of occlusion is adopted. The passage of the blood through the vessel ceases, and its proximal end as far as the next patent branch soon begins to contract, though remaining somewhat distended for a short time by the impact of the blood-stream. It is ultimately converted into a fibrous cord, which may or may not be pervious for a short distance. Blood is conveyed to the vessels of the limb below the ligature by anastomosing branches, which rapidly undergo dilatation and establish a *collateral circulation*, sufficiently free as a general rule to maintain the vitality of the part. These collateral branches become permanently enlarged, lengthened, and tortuous, and their walls thickened. If for any reason the collateral circulation is insufficient, gangrene is likely to supervene, starting in the parts furthest away from the centre of the circulation, or in the structures of least vitality (*e.g.*, the fingers, toes, or subcortical white substance of the brain), and spreading backwards until a part is reached which receives enough blood to keep it alive.

Arterial Hæmorrhage.

Three forms of arterial hæmorrhage are described, viz., primary, secondary, and secondary.

Primary Arterial Hæmorrhage is met with under two conditions: from an open wound, or where an artery is ruptured or punctured subcutaneously, so that extravasation into the tissues occurs, constituting either a severe bruise if the artery is small, or if the vessel is large what has been badly termed a 'diffuse traumatic aneurism.' The general rules for the surgical treatment of both these conditions are identical, and although the agent employed to finally arrest the bleeding varies according to the surgeon's personal predilections, yet the underlying principles hold good in all cases. We shall limit ourselves to speaking of the ligature.

A. **Primary arterial hæmorrhage from an open wound.** The blood is at once poured forth upon the surface, and escapes freely, so that the full constitutional effects are experienced.

The *principles* that guide us in its **Treatment** may be enunciated as follows:

1. *That the vessel must be secured at the bleeding-point*, an operation to expose it being undertaken if necessary. However infiltrated the part, the rule of cutting down to expose the wounded vessel is to be adhered to, with one or two exceptions noted below, and this for two reasons: (*a*) It is often impossible to know the exact source of the hæmorrhage unless it is laid bare. Thus, the bleeding from a lacerated wound of the front of the leg, which was apparently caused from the anterior tibial artery, was proved on incision and careful dissection to come from the peroneal, the wound extending backwards between the bones. In the axilla and groin such uncertainty often exists. (*b*) Proximal ligature of a vessel at some distance above the bleeding spot is commonly insufficient to arrest the

hæmorrhage, since the collateral circulation is quickly established, and then reactionary hæmorrhage is very likely to ensue.

2. *That both ends of the wounded vessel must be secured* if it is completely divided, whilst if it is only punctured, a ligature must be placed on each side of the puncture, and the complete division of the vessel effected. The ease with which collateral circulation is established justifies such treatment in the case of all arteries of large size. Thus, where the facial artery is divided, jets of blood are emitted from each end quite freely, and with nearly as much force from the distal as from the proximal. Occasionally the distal end of a bleeding vessel retracts amongst the infiltrated tissues to such an extent as to render its isolation impracticable. The surgeon must then trust to plugging of the wound from the bottom, but not until every effort has been made to secure it.

It is only needful to undertake the measures detailed above in cases where primary hæmorrhage is actually proceeding. If it has been once arrested, it is unnecessary to search for the bleeding spot unless the patient is very faint and collapsed, and the surgeon has reason to anticipate that a large trunk has been injured. Under such circumstances it may be needful to seek for and tie it at once, otherwise recurrent hæmorrhage is likely to ensue when the heart's action becomes more vigorous.

There are a few exceptions to the general rule of tying a wounded vessel at the injured spot, *e.g.*, where the depth of the dissection might endanger important parts, as in dealing with the deep palmar and plantar arches, or with the secondary branches of the carotid.

In the actual treatment of any particular case, ***temporary arrest*** of the bleeding may usually be effected *by digital compression* either of the bleeding-point or of the main trunk at a favourable spot nearer to the heart, against some resisting structure, such as a subjacent bone. The *common carotid* is controlled by grasping the neck from behind, and compressing the artery by the fingers placed along the anterior border of the sterno-mastoid against the transverse process of the sixth cervical vertebra (Chassaignac's tubercle). Such pressure will also control the vertebral and inferior thyroid vessels. The *subclavian* is to be compressed in the third part of its course against the first rib by the finger or thumb placed immediately behind the clavicle, the palm of the hand resting over the shoulder. A good deal of force is required in order to maintain the pressure, and this may be gained by superimposing the fingers or thumb of the other hand. Where the pressure is to be kept up for some time, the handle of a doorkey well padded may be employed in the same way, or an incision may be made and the vessel exposed, and directly controlled by digital pressure. The *facial* artery is compressed against the lower jaw just in front of the masseter muscle. Bleeding from the *labial* and *coronary* arteries is commanded by inserting the index finger into the corner of the mouth, and compressing the lip between it and the thumb outside. The *temporal* artery should be compressed against the zygoma just in front of the ear, the *occipital* at a spot

about 1½ inches from the occipital protuberance against the superior curved line. To control the *brachial* artery, the arm should be grasped from behind, and the fingers pressed inwards along the inner margin of the biceps against the humerus. The *radial* and *ulnar* arteries are easily commanded above the wrist by using both hands to grasp the forearm, with a thumb on each vessel. The *abdominal aorta* is temporarily controlled in slim individuals with ease by pressure through the abdominal wall against the body of the third lumbar vertebra at a point a little above and to the left of the umbilicus, *i.e.*, just above its bifurcation; in stout persons this is impossible. The *common femoral* artery is best compressed just below Poupart's ligament. The surgeon should stand on the same side of the patient as the artery to be controlled, and use either the finger-tips or thumbs to press the vessel directly backwards against the pubic ramus. The fingers of one hand placed over the other may sometimes be necessary to maintain sufficient command, or the thigh may be encircled by the two hands, and one thumb laid over the other. Care must be taken not to let the vessel roll aside, and so escape compression. When the artery has to be controlled for some time, as in an amputation, the hands may be used alternately, the one to rest the other. Such pressure will suffice for the temporary arrest of hæmorrhage from any part of the lower limb. If it is desirable to control the *anterior and posterior tibial* arteries close to the ankle during operations upon the foot, the assistant who steadies the limb accomplishes this by grasping the toes with one hand, and with the other compressing the vessels, the posterior tibial at a spot a finger's breadth behind the internal malleolus, the anterior midway between the two malleoli.

As digital compression cannot, however, be comfortably maintained for long, *mechanical compression* of a limb, as by tourniquet or elastic bandage, must be requisitioned. Possibly the screw tourniquet will be the best to apply, as it can be relaxed and tightened again as often as is necessary during the operation. In some cases it is advisable to exsanguinate the limb by elevation before applying the tourniquet.

The wound is then, if need be, enlarged by incisions, which, whilst laying the parts freely open, should inflict the least possible damage on surrounding structures. All coagula are removed, and the wounded vessel looked for. It may be needful to relax the tourniquet, and allow a jet of blood to escape, in order to ascertain its position. Both ends should be sought for and tied, a proceeding easier said than done. This especially applies to the distal end, which retracts, and often does not bleed at the time of operation, but may do so when the collateral circulation becomes established.

☞ For **Subcutaneous Rupture of an Artery**, see p. 203.

Recurrent, Intermediate, or Reactionary Arterial Hæmorrhage.

Such are the terms applied to bleeding which recurs within twenty-four hours of an accident or operation. It is an evidence of the failure of the means employed to arrest permanently the primary loss of blood, and may result from two chief causes: (*a*) Defective application of a ligature, which comes undone from being badly tied (a 'granny' knot), or slips off from including within its grasp other structures as well as the arterial wall; or (*b*) the coagula lying in the mouths of divided vessels are not sufficiently firm to withstand the increasing blood-pressure which supervenes after the shock has passed away, or which may be due to excitement or the injudicious administration of stimulants. It is usually due to the second of these causes, and is then not very serious, inasmuch as it can only arise from the smaller vessels, all the larger ones having probably been recognised and tied during the operation.

Treatment.—Elevation and the pressure of a firm bandage are often quite sufficient to arrest this form of bleeding; but if unsuccessful, the wound must be opened up, washed out with hot or cold lotion, and any bleeding vessel tied. The actual cautery may even be employed to check oozing from cicatricial surfaces, and if it is not allowed to touch the skin, and the wound kept aseptic, no delay in its healing need be occasioned. Should the bleeding persist, the wound should be firmly packed.

Secondary Hæmorrhage.

Under this title are included all forms of hæmorrhage from wounds which occur after the lapse of twenty-four hours. It is usually due to sepsis, and was formerly very common, often leading to a fatal termination; but since the introduction of antiseptic surgery it is but seldom seen. Where antisepsis, however, cannot be efficiently carried out, as in the mouth, pharynx, etc., it is still occasionally met with.

The **Fundamental Cause** in the production of secondary hæmorrhage is without doubt a **septic condition** of the wound. This may act in various ways. Thus, in a vessel entirely divided, the cocci may gain entrance through the open mouth to the internal coagulum, and by causing its disintegration, break down the barrier which Nature had raised against such an occurrence. This process is assisted by an ulcerative form of peri-arteritis, which leads to the maceration and softening of an absorbent ligature, and to weakening of the vessel walls. It is in this latter way that secondary hæmorrhage is induced in vessels ligatured in their continuity, the loss of support due to the opening up of the septic wound being also an element of danger. We desire here to emphasize the marked alterations in all the conditions existing in a septic as opposed to an aseptic wound. In the latter it is not only the clot in the lumen of the vessel which is relied on to prevent accidents, but the vital action of all the tissues is calculated to work in the same direction, that of insuring the patient against hæmorrhage; in fact, the occurrence of secondary

diminish the vitality of the arterial tunics just below the point o ligature, and thus unduly expose this part to bacterial activity.

The **Treatment** is a matter of grave anxiety until the wound get into a healthy state, inasmuch as the surgeon can never be certai that the bleeding will not break out again, although it may hav been temporarily stayed; hence such a case must be most carefull watched. If the wound is in a limb, a tourniquet should be lightl adjusted above it as a precautionary measure, so that at a moment' notice it may be tightened.

When arising *from an artery entirely divided across*, as in an ampu tation stump, elevation of the part, exposure to the external ai bathing it with cold lotion, and then re-dressing and firmly bandagin it, may be all that is needed in the early and mild cases. A recu rence will necessitate the opening up of the wound, and the applica tion of ligatures to the bleeding-points, if practicable. The actu cautery may be employed where the tissues are too rotten to hold ligature. Means should be adopted to remove septic sloughs, as b a Volkmann's spoon, and if possible to render the wound aseptic b swabbing it out with strong carbolic lotion (1 in 20), or with a solu tion of chloride of zinc. The wound should then be powdered wit iodoform, packed with cyanide gauze, and firmly bandaged. I occurring later in the case, the wound should be freely opened, an an attempt made to secure the bleeding vessel by isolating it fo some little distance from surrounding structures. If this fails, owin to the sloughy or septic state of the tissues, the artery must be tie just above, or re-amputation performed. When the bleeding come from the main vessel near the trunk, as after amputation at th shoulder or hip, proximal ligature can alone be depended on, shoul local treatment be unsuccessful.

When coming *from an artery tied in its continuity*, the means indicate above should be adopted in the early stages. Later on, the treatmen varies a little according to the situation. If from a vessel of th *trunk*, such as the carotid or iliac, the wound must be freely opene up, and the artery secured again above and below, whilst every effor is made to combat the septic condition by plugging with antisepti materials. Failing this, if proximal ligature is impossible, one ca only trust to pressure. In the *arm*, after using cold, pressure, an elevation, one would re-tie above and below through the origina wound. If this fails, a ligature should be applied higher up through a separate incision, or finally amputation be performed. In the *leg* however, it is scarcely wise to attempt re-ligature at a higher spot owing to the less abundant collateral circulation. If the hæmorrhag ceases, gangrene is very likely to ensue; whilst if the latter does no supervene, hæmostasis will probably not be effected. Under suc circumstances amputation must be undertaken without delay.

Venous Hæmorrhage.

Bleeding from the smaller veins rarely requires much attention, in that the walls, when once divided, rapidly collapse, and this effectually checks further loss of blood; but if the larger veins are involved, or if the walls are thickened and rigid, as in varix, a very considerable amount may be lost, the blood welling up in a dark, purplish stream from the wound, and rendering its arrest the more difficult from the fact that, except in veins of the largest size, there is no definite jet or gush to guide one to the wounded spot.

Treatment of Venous Hæmorrhage.—The same means to a large extent must be employed as for arterial hæmorrhage, but it is less frequently required, since the smaller veins collapse naturally, and thus the bleeding stops. It is seldom advisable to occlude the whole circumference of a large vein if it can be avoided, since a puncture or tear can often be secured without seriously encroaching upon the calibre of the tube. In amputations it is usual to tie both the main artery and vein. Where it is difficult to reach a vein in order to tie it, the wound may be stuffed.

The **dangers** of venous hæmorrhage are fourfold: (1) The constitutional symptoms arising from the actual loss of blood, details of which have been given above; (2) the thrombus which forms may become displaced as an embolus; (3) septic infection of the thrombus lying in the mouth of the vessel may lead to pyæmia; and (4) the **entrance of air into veins**, which, though rarely met with, is fraught with the most urgent danger to the patient. The air becomes churned up in the cavities of the right side of the heart, forming a spumous, frothy mixture amongst the columnæ carneæ, which the heart can only with difficulty eject; thus the circulation is brought to a standstill in spite of forcible cardiac contractions, and the patient dies from anæmia of the lungs and brain.

The **Cause** of the entry of air is usually a wound of some vein in what is known as the 'dangerous region' of the neck or axilla, or even of such unlikely structures as the pelvic veins or cranial sinuses. There is but little blood-pressure within the veins at any time, but during inspiration the movements of the thorax exercise an aspiratory or suction effect upon the blood in the veins of the neck, a most important element in the maintenance of the venous flow. Any condition which tends to prevent the collapsing of the walls of the veins, or brings about what is termed their **canalization**, predisposes to this accident. Thus they may be held open at spots where they pierce the deep fascia or the platysma; if the coats are thick and rigid from inflammation, or surrounded by indurated tissue, or button-holed as by excision of a portion of the walls or division of a branch close to the main trunk, or if undue traction is exercised upon the pedicle of a tumour containing a wounded vein, then the orifice may remain patent, and air can be sucked in. If, however, the veins are very distended, and the intravenous pressure high, as is often seen in the

operation of tracheotomy, then the wound of a vein, even in the dangerous area, usually results in loss of blood rather than entrance of air.

Signs.—The entrance of air into a wounded vein is accompanied by a hissing, gurgling, or sucking sound, which is quite characteristic. A few bubbles of air may also be seen clinging about the aperture in the vessel. If only a small amount has entered, or if the entry is made slowly, no bad results may follow; but the usual effect of the sudden introduction of even a small quantity is to produce severe faintness, and if the patient is conscious, a feeling of dyspnœa and distress, which is partly cardiac in origin, partly due to obstruction to the flow of blood through the lungs. The pulse becomes rapid and almost imperceptible, the pupils widely dilated, and death usually follows, preceded perhaps by convulsions, although the fatal issue may be postponed for a few hours. If the patient survives, no after-effects remain.

Treatment.—This accident can usually be avoided by dealing cautiously with all veins in operations about the neck. Should it occur, any fresh entrance must be at once checked by placing a finger over the bleeding-point or pouring lotion into the wound. The vein should be secured by ligature as soon as possible. Compression of the chest has been recommended by some authorities in order to squeeze out the air that has entered; but there is little chance of attaining this end. To combat the general symptoms, it is essential to maintain a good supply of blood to the brain. The head is lowered, and, if need be, the limbs raised and bandaged, or the abdominal aorta compressed. Stimulants and artificial respiration are used in order to maintain the heart's action and to overcome the pulmonary obstruction. Warmth and friction are also applied to the extremities.

Capillary Hæmorrhage.

This is usually of little significance. It is characterized by a general oozing from the wounded surface, the blood trickling down to fill the cavity from the bottom. It is often very abundant from inflamed parts, and especially from fibro-cicatricial tissue, which prevents the closure of the vessel mouths. It can usually be arrested by a little pressure, or by the application of cold or hot water, by styptics, cauterization, or plugging.

Methods of Dealing with Hæmorrhage from Special Sources.

Carotid Artery.—Treatment is impossible unless the surgeon is on the spot, when both ends should be tied.

Jugular Vein.—Tie, or stitch, if possible, without occluding the whole lumen.

Secondary Branches of the Carotid.—It may be difficult to secure the divided ends of these vessels either in the neck or head, *e.g.*, in a cut throat or a punctured wound of the pterygoid region. Under such circumstances, ligature of the external carotid between the superior thyroid and lingual has been recommended as more satisfactory than tying the common carotid, since the cerebral circulation is not thereby affected.

rtery. — The source of such bleeding may be difficult to ascertain, ely possible to compress this vessel without also including the hence mistakes in diagnosis have often arisen. It may be feasible, ontrol the carotid alone by pinching it up by the fingers placed e of the sterno-mastoid, without interfering with the vertebral. ist follow the usual course of cutting down and tying at the t, if possible. To do this, the incision must be enlarged, or a new ng the posterior border of stoid in order to define the cesses of the vertebræ. In rt of its course the vessel ared by clipping away a cess if necessary, due care of the nerve roots; other- g of the vertebral canal or ctics must be depended on. ssential that the carotid e tied by mistake in these eby more blood is directed al trunk, and the bleeding ngly increased.

al Mammary Artery rarely tment, since a punctured s vessel is usually compli- ne graver mischief to heart, It recognised, tie at the possibly removing a costal un access. The vessel lies outside the border of the

FIG. 80. HAND, TO SHOW POSITION OF PALMAR ARCHES

A, Radial artery; B, ulnar artery; C, superficial arch; D, deep arch.

Hæmorrhage usually results ing wounds also involving is not easily stopped on position of the vessels in

Treatment. — Incise the ongitudinally along the of the rib, and detach it els from the groove; or ion of the bone, and thus expose the bleeding-point; or in some passed round the rib a little above the injury has sufficed; or again, be employed by pushing a piece of aseptic gauze, like a pocket, ound into the pleural cavity, and then stuffing it tightly with wool gauze, so that on pulling upon it the vessel may be effectually

the **Vessels of the Extremities** need treatment according to the nciated above. Only one or two require special mention.

the **Palmar Arches** were formerly much more dreaded than they , when thorough antisepsis and the use of the elastic tourniquet xplore the depths of a wound without much danger or difficulty. of the wound will usually indicate whether the bleeding comes from or deep arch, but in case of doubt it is well to remember that e ulnar trunk mainly affects the superficial arch, whilst pressure on ll chiefly influence the deep. A wound of the superficial arch trouble in treatment, as it can be readily secured by catch forceps but the deep arch is not so easily dealt with. It lies just over the netacarpal bones (Fig. 80, D), and to expose it the wound must be d by a longitudinal incision, and the tendons turned on one side or may be possible to secure the vessel by forcipressure forceps, and left on for twenty-four hours if a ligature cannot be applied. Of ictest asepsis is needful in such cases, and passive movement of the be early undertaken, in order to prevent troublesome adhesions.

Failing such means, or in septic wounds, the wound is carefully plugged wi gauze, and over this the fingers are firmly bandaged. The patient is kept in be for a few days, and the arm elevated. Pressure on the main vessels above i scarcely necessary if the compress is accurately applied. The bandages may b relaxed at the end of twenty-four hours, but the deep dressing should, if possibl not be touched for three or four days. If, in spite of this, bleeding recurs, th main vessel or vessels of the limb must be tied. Ligature of the ulnar and radi at the wrist is generally insufficient to control it, as there is often a communicatin branch of some size passing from the anterior interosseous to the deep arch, an hence it may be needful to secure the brachial artery, ascertaining first, howeve by pressure that such would be efficacious; for occasionally there is a hig division of the brachial, or a vas aberrans may exist, which would compel th surgeon to tie the third part of the axillary.

Bleeding from the **Plantar Arch** must be conducted on similar lines.

The **Gluteal, Sciatic,** or **Pudic** arteries may be wounded by stabs in the buttock *Treatment.*—Enlarge the wound in the direction of the fibres of the glutei maximus, *i.e.*, downwards and outwards, and secure the bleeding vessel. Th gluteal trunk emerges from the pelvis at the junction of the middle and inn thirds of a line from the posterior superior iliac spine to the great trochanter the pudic crosses the ischial spine at the junction of the middle and lower third of a line from the posterior superior iliac spine to the tuber ischii. The sciati emerges from the pelvis just above and a little external to the latter spot. Th pudic may also be divided in the perineum by a penetrating wound. Failin ligature of any of these arteries at the seat of bleeding, the internal iliac ma need to be secured.

Hæmophilia.

By hæmophilia, or the hæmorrhagic diathesis, is meant a congenital an hereditary disease characterized by a tendency to persistent and uncontrollabl bleeding from slight wounds, whether open or subcutaneous. This condition i often associated with extravasation of blood into the joints, and certain co secutive phenomena (Chapter XXII.). The family history is always interestin the disease being usually transmitted through the females to the males of succeeding generation, whilst the former often escape entirely. The pathologic cause of this affection has not yet been ascertained, no change in the vessels constitution of the blood having been discovered. Unless hæmorrhage is actual occurring, nothing abnormal is noticed, but any injury is sure to be followed excessive bleeding; spontaneous subcutaneous ecchymoses frequently occur, also bleeding from the mucous membranes. Hence no operations must be unde taken on such patients unless absolutely urgent, even such a small matter as th extraction of a tooth having proved fatal.

The **Treatment** of hæmophilia should be directed more to correcting th constitutional defect than to pursuing the usual practice in dealing with hæmo rhage. The application or administration of hæmostatics, and substances whic tend to promote coagulation and the formation of fibrin, should be resorted t Calcium chloride, 1 drachm to ½ pint of water, given by enema, or 30 grs. by th mouth, repeated several times a day, has been recommended, whilst fibri ferment, suprarenal extract, and cocaine should be employed locally. Positio and pressure are attended to, and in severe cases the actual cautery may prov useful, or the prolonged application of cold.

artery is ruptured in a subcutaneous injury, such as a fractu location, extensive extravasation often ensues, constituting dition badly termed a **Diffuse Traumatic Aneurism.** The obj this name lies in the fact that there is no true sac wall aneurism, the only boundary consisting of an ill-defined ma coagulum, partly inflammatory exudation, and in part thick infiltrated tissues. A similar condition may ensue from a p wound dividing a vessel, where the track leading to it is va becomes closed by clot or some external application.

Symptoms.—The patient usually feels a snap, as though s had given way, accompanied by a sudden pain, localized to injured, and often shooting down the limb in the line of th These are succeeded by the following phenomena: (*a*) *Lo* formation of a diffuse, rapidly increasing swelling, the s which is at first normal, but soon becomes distended and bl finally bright red and œdematous, when the tumour is threa give way. There is no increased local heat except in the lat Distinct pulsation is usually present, and some amount of bruit, synchronous with the heart's action, although thes quently become less obvious. (*b*) *Distally*, diminished sens the limb quickly follows, together with loss of pulsation in th and a fall of temperature. It lies more or less useless an and in colour is either white and blanched, or may be cong œdematous if the extravasated blood presses upon the venou (*c*) *Generally*, the signs of hæmorrhage and shock manifest th in varying degree, according to the amount of blood lost character of the violence.

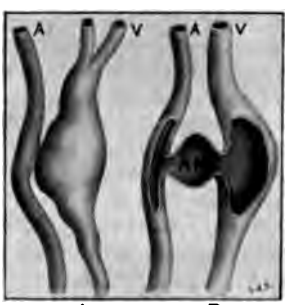
Results.—(1) The swelling may increase steadily in size skin becomes so distended as to *rupture* or slough, and then, not at hand, the patient dies of hæmorrhage. Occasi bleeding continues into an internal cavity, or into the tis limb, to such an extent as to cause death without any ext of blood. (2) *Suppuration*, accompanied by the general sign may result from auto-infection, or from the entrance of through the small valve-like wound. The whole swelling red, hot, œdematous, and excessively tender, looking lik abscess. Rupture and external hæmorrhage will probably the case if surgical assistance cannot be obtained. (3) The of the extravasated blood upon the veins or on the arteri for the collateral circulation may determine *gangrene* of the which is almost always of the moist type. (4) The pro become more or less *limited* after a time by coagulation oc the divided mouth of the vessel, which is thus occluded. circulation may be established, and thereby the health and the limb are maintained, whilst the blood-clot is absorbed or

The **Treatment** is necessarily the same as for a divided a municating with an open wound, viz., to cut down and tie The circulation is first temporarily arrested by an elastic t a free incision made, and all coagula removed. The bleed

can, however, only be required under very exceptional c stances.

In punctured wounds of arteries the size of the penetratin is all-important. A vessel may be traversed by a needle v hæmorrhage or any subsequent ill effect, but a larger puncture in extravasation. If it ceases after a time, the blood-clot is ab and the wound in the vessel closed by a cicatrix, which may quently yield to the blood-pressure, and give rise to a circum aneurism. This occurrence is not unfrequent in the neighbo of the wrist from glass wounds, involving the radial or ulnar and hence is not uncommon among window-cleaners or miners bottlers.

Arterio-Venous Wounds are not so frequent in the present formerly, when venesection was in vogue. They follow pene wounds which involve an artery and vein lying in close conta at the bend of the elbow between the median basilic vein a brachial artery, in the neck between the internal jugular and c



A B

FIG. 81.—DIAGRAMS OF *A*, ANEURISMAL VARIX AND *B*, VARICOSE AN A, Artery; V, vein; AN, aneurism.

in the groin between the femoral vessels, and occasionally orbit. They are also met with in military surgery, owing to the of the modern bullet and the limited amount of danger cause in the soft tissues. Two conditions may result.

An **Aneurismal Varix** is produced by a direct communicati tween an artery and a vein, no dilated passage intervening b the vessels (Fig. 81, *A*). The venous walls, unfitted to wit arterial pressure, are thereby dilated and rendered varico pulsating venous tumour results, the dilatation extending for a v distance above and below the opening, and at each beat of th a loud whizzing sound can be heard, likened by some authors caused by an imprisoned bluebottle buzzing in a thin paper ba palpation the thrill of the blood as it enters the vein can o detected.

Treatment.—Nothing is usually required beyond the applica

thereby produced leads to softening of the vessel walls, the fi which lose their cohesion with each other. Finally, their re power may be so impaired that they yield before the blood-p and cause hæmorrhage, unless thrombosis has previously seal vessel. In the smaller arteries this is usually the case, but i larger than the radial there is considerable danger of bl especially if the irritation is confined to one side of the Secondary hæmorrhage from arteries tied in their contin generally due to this cause, as also bleeding from phthisical c the vessels having previously lost the support of surrounding t and being more or less dilated or aneurismal. Acute ab septic ligatures, and malignant tumours may weaken an arteri and lead to hæmorrhage, whilst the infective agent sometimes a the walls from within, as from an infective embolus.

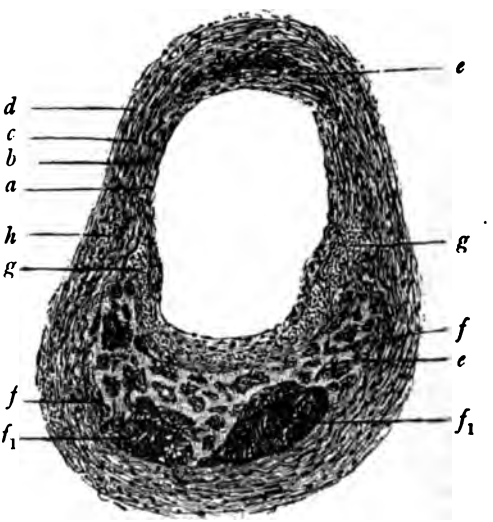


FIG. 82.—SECTION OF ATHEROMATOUS CEREBRAL ARTERY. × 50. (Zi
a, Intima considerably thickened; *b*, bounding elastic lamella of *c*, media; *d*, adventitia; *e*, necrosed denucleated tissue with masses detritus; *f* and f_1, detritus with cholesterine tablets; *g*, intima i with leucocytes; *h*, infiltration of adventitia with leucocytes.

3. **Embolic Arteritis.**—When a vessel is blocked by a embolus, obliteration as a result of a simple plastic arteriti usual consequence. If the embolus contains some irrita infective material, as in a case of infective endocarditis or p an abscess may result; but if the irritant is less intense, the may stop short of suppuration, and yet an aneurismal dilat the softened wall takes place. The latter process is the most c cause of *spontaneous* aneurism in children.

4. **Acute Endarteritis** is met with rather as a pathological c

than as a condition of any clinical import. It is usually associated with acute endocarditis, however produced, or may accompany some of the chronic forms described below. It is evidenced by the presence on the inner aspect of the vessel of more or less raised patches, somewhat pinkish and gelatinous in appearance, soft and elastic in consistency; and although the polish is lost, the endothelium is usually intact. It is found in the aorta, or in smaller vessels, especially near inflamed wounds.

3. **Chronic Endarteritis** is an exceedingly common affection, and the following forms may be described:

a. **Simple Chronic Endarteritis**, resulting in **Atheroma** (Gr. ἀθήρη, 'gruel' or 'pap'). This condition is constantly found in elderly people, but especially in drinkers and those who have suffered from chronic Bright's disease, gout, or syphilis; it arises from continual strain and increased blood-pressure, and hence often starts in the interval of the aortic arch, at the spot where the impact of the blood-stream is most felt as it is ejected from the ventricle, or in places where a vessel passes over or around some bony projection, or at the bifurcation of a main artery, or where a large branch is given off, thus causing a sudden decrease in its lumen. It is rarely found in the smaller arteries, except those of the heart or brain.

Its *pathological* phenomena consist at first of a proliferation of the deeper parts of the tunica intima, giving rise to opaque, milky-looking, non-vascular patches (Fig. 82, *g*), which may organize into fibroid tissue, or undergo fatty degeneration (*e* and *f*). They are arranged longitudinally or around the mouths of large branches. The tunica media is more or less involved in the process, and the adventitia is often thickened externally. As soon as the fatty changes have commenced, the patches become yellowish in colour, somewhat raised from the inner surface, and irregular in outline; they are small at first, but increase in size, and coalesce one with another. Their contents are now fluid or cheesy in consistency, constituting the so-called 'atheromatous abscess,' although no true pus exists, the contents being material consisting of fatty granules and débris, with oil globules and plates of cholesterine (Fig. 82, f_1). It may be absorbed entirely, leaving a weakened spot in the wall of the vessel, from which an aneurism may arise; or the tunica intima may give way internally, allowing the contents to be swept into the general circulation, when it probably does no harm, and the raw surface left behind is known as an 'atheromatous ulcer.' The outer coat has by this time become thickened, and hence no immediate ill result follows the breach in the inner coats, although subsequently dilatation may take place, even though cicatrization of the ulcer has occurred. Again, the blood may find its way through the opening into the substance of the wall and strip up the inner from the outer layers, constituting a 'dissecting aneurism'; or a localized thrombus may form, causing occlusion of the vessel.

Not uncommonly the cheesy contents of the abscess become inspissated, and later on infiltrated with lime salts, resulting in the

formation of calcareous plates, which are either covered wi
thelium, or exposed to the blood-stream, and hence ma
thrombosis, or become detached as an embolus, or the bl
get in under the plate and form a dissecting aneurism.

A condition of endarteritis evidenced by proliferation of th
intima is always met with in chronically inflamed tissues, a
diabetes; such does not, however, run on to atheroma.

(*b*) **Chronic Syphilitic Endarteritis** is chiefly met with in the
stage, and is characterized by an overgrowth of the tunic
(Fig. 83, *a*), which is subsequently associated with infiltratio
media (*c*), and much more so of the adventitia (*d*). The
occurs in small arteries, especially those of the brain or kid

FIG. 83.—SYPHILITIC ARTERITIS. × 150. (ZIEGLER.)

a, Intima greatly thickened by newly-formed fibro-cellular tissue; *b*, fi
elastic lamina of Henle; *c*, muscle fibres of media, infiltrated to
left; *d*, adventitia thickened by cell infiltration and hyperplasia.

in the neighbourhood of gummata, and but rarely in th
vessels, although a considerable percentage of individuals
with internal aneurism have suffered from syphilis. It diff
simple atheroma (1) in attacking small arteries; (2) in affec
whole circumference of the vessel, and not merely patches;
newly-formed tissue becomes vascular, and does not under
degeneration; and (4) it leads to narrowing or occlusio
vessel rather than to weakening and dilatation. When invo
cerebral arteries, various forms of monoplegia, or even hem
may result.

(*c*) It is still more or less an open question whether the
Endarteritis obliterans or **proliferans** is truly syphilitic or i
some cases a syphilitic history has been present, but in other

retarded, or the lumen of the tube narrowed, complete throm may follow, the clot extending some distance up or down the v or even from a branch into the main trunk, which may be block this means. **Aneurism** is also a result of any weakening o arterial tunics. **Obliteration** of the artery is caused, either by t bosis, or by excessive proliferation of the tunica intima (as in syp or tuberculous disease), or by gradually increasing pressure without. Lastly, **Spontaneous Rupture** is occasionally produced.

Peripherally, defective blood-supply and consequent **lowered vi** are the most marked results of arterial disease, leading to va forms of ulceration and gangrene. Thus, senile gangrene is d

FIG. 84.—PRIMARY CALCAREOUS DEGENERATION OF ARTERIES. (FRO COLLEGE OF SURGEONS' MUSEUM.)

calcareous changes in the arteries, fatty degeneration of the l follows atheroma of the coronary arteries, whilst softening o brain may ensue from various affections of the cerebral ve Similar results may also arise from **emboli** detached from are local disease.

Aneurism.

An **Aneurism** is a tumour filled with blood communicating wi interior of an artery, and due to dilatation of part or the whole o vessel walls.

Causes.—Aneurisms may be divided into the pathological and the traumatic, the distinction between them being that in the former the coats of the artery are primarily diseased, whereas in the latter they may be previously healthy. However, it must not be forgotten that persons with diseased arteries are just as liable to injury as, and even more so than, those with healthy vessels, and thus no strict line of separation can be drawn between the two forms. The causes of aneurism may be conveniently grouped under two headings:

1. **Changes in the Vessel Walls,** by which their resistance to the intravascular pressure is diminished. Many varieties of *disease, e.g.*, atheroma, predispose to aneurismal dilatation, especially if occurring in syphilitic or gouty men about middle life, in whom, although the arterial tunics may be weakened, the power of the heart and the resulting blood-pressure are by no means diminished. Calcification, on the other hand, is antagonistic to aneurismal dilatation. Any *injury*, a contusion, a penetrating wound, or a strain, may so interfere with the integrity of the vascular coats as to result in aneurism, and, indeed, a cicatrix in an arterial wall must always be looked on as a weak spot predisposing to dilatation. The lodgment of an *embolus* in the smaller arteries is stated to be one of the most common causes of spontaneous aneurism in young people.

2. **Increase in the Blood-Pressure** is another factor, especially when due to heavy *strain* or *exertion*, which leads to irregular excitement and increased action of the heart. Steady laborious employment, such as is seen amongst artisans and mechanics, or regular exercise, does not appear to predispose to this condition; but irregular intermittent efforts, in which for the time being every power is strained to its utmost, are very liable to determine its occurrence. A day's exertion in the hunting or shooting field by an elderly man, accustomed to sedentary occupations, is often the cause of some vascular lesion, such as aneurism, apoplexy, etc. Hence aneurisms are more frequently seen amongst men than in women, in the proportion of seven to one; whilst they are much more common among the dwellers in Northern climates than in the more lethargic and ease-loving inhabitants of the South. The energy and activity of the Anglo-Saxon race especially predispose them to this disease.

Structure of an Aneurism.—Formerly much stress was placed on the terms *true* and *false*, the word 'true' meaning that all the coats of the vessel were present, whilst the 'false' were those in which the sac wall comprised little or none of the original arterial tunics. This distinction is of comparatively little value, since no aneurism which has attained to any size is in reality true. The *sac* consists more or less evidently of a distension of all or part of the original walls of the vessel whilst it is small; but as the aneurism increases, the original structure is replaced by a mass of newly-formed fibrous tissue, due to a condensation and matting together of the surrounding structures, with or without an internal lining of laminated fibrin deposited on parts where the endothelium has disappeared. The *contents* of the sac depend on the character, age and size of the

aneurism. Whilst still small and with a complete endothelial it contains fluid blood; but as the tumour grows, and especiall the sacculated type, fibrin is deposited in layers which gr encroach on the cavity and may in time completely fill it, so rare cases a spontaneous cure results. The oldest laminæ a and yellowish-white in colour (the so-called *active clot* of E those more recently deposited are softer and more reddish, whi last formed is merely like ordinary blood coagulum (the *passive* Broca). No single lamina covers the whole area, but layer is an over layer (Fig. 85) in such a manner that the oldest and nece the smallest laminæ are nearest to the sac wall.

FIG. 85.—SACCULATED ANEURISM. (MUSEUM OF ROYAL COLLEGE SURGEONS.)

The small mouth of the saccule is clearly seen, and the cavity is nearly with laminated clot.

Three chief forms of aneurism have been described: the fu sacculated, and dissecting.

1. The **Fusiform Aneurism** (Fig. 86, A) is one in which the lumen of the vessel is more or less equally expanded, so th swelling is tubular in character. It is due rather to a general in of blood-pressure, or to a widely extended disease of the arterial than to any localized lesion or injury, and hence is more com met with in the larger internal vessels than in those of the extre The tunica intima is usually represented throughout the whole of the sac, but is thickened and atheromatous in patches, the m

and surfaces of calcareous plates being indicated by flocculi of fibrin, which are attached to them, although no regular laminated deposit may be present. The tunica media is stretched, atrophied, and in the later stages practically non-existent, whilst the adventitia is much thickened by inflammatory new formation and by incorporation with the surrounding tissues. The progress of fusiform aneurisms is generally slow, so that in some situations, *e.g.*, the thorax, they may attain enormous dimensions, and cause grave symptoms by their pressure. A natural cure is almost impossible, and hence, if unchecked by treatment, a fatal termination is caused by rupture or by implication of important neighbouring structures. Frequently one portion of the aneurismal wall yields more than another, and thus a localised sacculation is superadded, which by its rapid increase in size may destroy life.

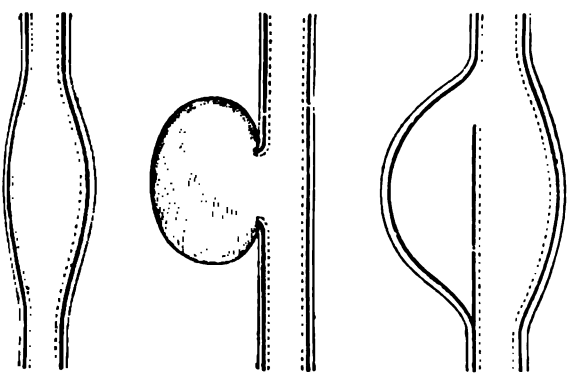


FIG. 86. DIAGRAMS OF FUSIFORM, SACCULATED, AND DISSECTING ANEURISMS.

In the first the walls are expanded, but more or less normal in texture; in the sacculated, the normal structure of the arterial wall ceases abruptly at the commencement of the saccule; in the dissecting, the arterial wall is split into two lamellæ.

The interrupted fine line is supposed to represent the intima; the continuous dark line, the media; and the continuous fine line, the adventitia.

2. A **Sacculated Aneurism** (Figs. 85 and 86, B) is due to the yielding of some weak patch in the vessel wall which does not involve the whole circumference, or, as just mentioned, it may spring from a fusiform aneurism. It communicates with the interior of the artery by an opening of variable size. All traumatic aneurisms, whether due to the yielding of a cicatrix, or to the partial division of the coats of the vessel, are of this type, which is hence found most commonly in the extremities. The inner and middle coats can usually be traced as far as the mouth of the saccule, but there they are suddenly lost, the wall being constituted by a mass of fibro-cicatricial tissue, upon which laminated fibrin readily forms, thus increasing its thickness and power of resistance. Their progress is, however, much more

rapid than that of the fusiform, generally ending in rupture or diffusion, although occasionally a natural cure results. The blood as it enters the sac impinges against the wall furthest removed from the heart, and thence eddies back in circles, coagulation being thereby favoured.

3. A **Dissecting Aneurism** (Fig. 86, C) is one in which the blood forms a cavity within the wall of the vessel by stripping up the inner from the outer half, the line of cleavage being within the middle coat, half going with the adventitia, half with the intima. It is usually the result of extensively diffused atheroma. The blood thus driven into a cul-de-sac may remain limited to this cavity for some time, or it may find its way outwards and become diffused, or burst back through another atheromatous spot into the interior of the vessel. The condition occurs chiefly in the thoracic aorta, but cannot be recognised *ante-mortem*.

Symptoms and Signs of a Circumscribed Aneurism.—These may be divided into two groups: the intrinsic and extrinsic.

Intrinsic Signs.—A tumour, pulsating synchronously with the heart's beat, is present in the course of a vessel. The pulsations are distensile or expansile in character, *i.e.*, the whole tumour increases in size at each systole, and that evenly in all directions, so that if the tumour is lightly grasped in any position the fingers are separated. A definite thrill can often be felt as the blood enters the sac at each heart-beat. If the supplying vessel is compressed on the proximal side, the pulsation ceases, and the tumour diminishes in size and becomes softer; this is more marked in fusiform than in sacculated aneurisms. The application of pressure to the sac itself, whilst the afferent trunk is compressed above, may still further diminish its size. On removing the pressure, the swelling regains its old dimensions in a certain definite number of beats, usually not more than two or three. Pressure on the distal side of the sac makes it more tense and the pulsation more marked, unless such compression is very prolonged. On auscultating the tumour, a bruit of variable character may be heard; usually it is loud, harsh, and systolic, but sometimes quiet and musical. It is occasionally double in some forms of sacculated aneurism, and in the aorta when regurgitation through the aortic valves is also present. The bruit is loudest and most rasping in the fusiform variety, and may be absent in the sacculated form, when the mouth is small and the cavity nearly full of clot. Great distension of the sac is unfavourable to the production of a bruit.

The **Extrinsic Signs** of aneurism are those occurring in neighbouring or distal structures from its constantly increasing size and pressure, and the interference produced by it with the circulation. The *pulse* on the distal side is diminished and delayed, its diminution being caused partly by the obstruction experienced, but also in some cases by the pressure of the sac upon the trunk above or below the tumour. The delay is due to the interference with the transmission of the heart's impulse by the intervention of the aneurismal sac. The dicrotic notch is usually absent. The smaller vessels engaged

in establishing collateral circulation may be compressed, and thus the vitality of the limb considerably impaired. Pressure on the accompanying vein or *veins* results in diminution of their calibre, and possibly a localized thrombosis, together with distal congestion and œdema. Compression of *nerves* occasions neuralgia, spasm, or paralysis. *Muscles* are displaced, expanded, and attenuated; *bones* may be eroded, as evidenced by a deep, constant, boring pain, and even spontaneous fracture may ensue; whilst *joints* are encroached upon and disorganized. *Tubes*, such as the trachea or œsophagus, are often injuriously constricted and laid open by ulceration. It is an interesting fact to note that resisting tissues, like bone, are much more liable to be eroded than elastic, yielding structures, such as cartilage, and in cases where the vertebral column is encroached upon by an abdominal or thoracic aneurism, the bones always manifest greater destructive changes than the intervertebral discs.

The increased difficulty in propelling the blood through the sac usually induces a certain amount of compensatory hypertrophy of the *heart*. Fibrinous masses are occasionally set free as *emboli*, and lead either to a spontaneous cure, or to gangrene of the parts supplied by the vessel, or to death if the brain is involved. *Gangrene* may also be induced as a result of the diminished blood-supply to peripheral parts, especially if associated with interference with the venous return. It is usually of the dry type, involving merely one or two fingers or toes; but when attacking more fleshy parts, or if venous congestion is marked, it is moist in character.

The **Differential Diagnosis** of a circumscribed aneurism is usually not difficult, but the following conditions may simulate it somewhat closely: 1. A *tumour* or *chronic abscess* situated near an artery, and deriving *transmitted pulsation* from it, is recognised by the impulse being merely heaving in character, and not expansile; by the pulsation ceasing entirely if the tumour is lifted from the vessel, or allowed to fall away from it by assuming a suitable position; by the size of the tumour not diminishing if the pulsation is stopped by pressure on the vessel above; and by the fact that after stoppage of the pulsation the first beat is equal to the subsequent ones, whereas in an aneurism it almost always requires more than one beat to re-establish the strength and force of the impulse. Moreover, the pulse below is not affected in the same way or to the same extent as when an aneurism is present. 2. An *artery* is sometimes *pushed forwards* by an underlying growth, and its pulsation in a more than usually superficial position may suggest an aneurism. The distinguishing features are the limitation of the pulsation to the line of the vessel, and the absence of pulsation in the underlying growth. 3. A *pulsating sarcoma or nævus* is known by being rarely limited exactly to the line of the artery, pulsation being present in situations where an aneurismal dilatation could not be felt, and being less forcible and regular in its character. The consistency of the swelling is more variable, and pressure over the afferent trunk does not diminish its size to any marked extent. Moreover, a sarcoma is usually more adherent to

the deeper structures, and its limits are not so accurately defined. 4. The pain caused by an aneurism may lead it to be mistaken for *rheumatism or neuralgia* (*e.g.*, for sciatica in popliteal aneurism), and in every case of obstinate pain of this kind the arteries should always be carefully examined.

Natural Terminations and Results.—1. **Spontaneous Cure**, though very unusual, may occur in sacculated aneurisms. (*a*) It may be due to the *gradual* deposit within the sac of fibrin, which, in the first place, limits the expansion and extension of the aneurism, but may finally increase to such an extent as to occupy the whole cavity. This condition can only obtain in saccules with small mouths, and in vessels of the second magnitude, hardly ever in the aorta or larger trunks, the impetus of the blood-stream being too great to permit of the necessary deposit of fibrin. (*b*) It may arise as the result of the *sudden* coagulation of all the blood in the sac from the stoppage of the circulation, owing to the lodgment of an embolus either at the mouth of the aneurism or in the trunk immediately below. (*c*) The aneurism may become so large as to compress the main vessel, either going to or coming from it, thus bringing about its own cure. (*d*) Again, if the sac becomes inflamed, consolidation may occur with or without suppuration, although the latter process, as will be seen anon, is attended with serious danger to life and limb.

In the non-inflammatory conditions the sac becomes more and more firm, the pulsation less forcible and distinct, the bruit diminishes, and finally consolidation is effected, a firm fibroid tumour alone remaining, which gradually shrinks, whilst the collateral circulation is opened up so as to supply the limb below. It is sometimes by no means easy to recognise the fibroid mass resulting from the spontaneous consolidation of an aneurism, and in making a diagnosis the history has mainly to be depended on. The existence of a tumour in the line of an artery, the probable occlusion of the main trunk, and the fact that the circulation is carried on by means of collateral branches, are the chief points which can be ascertained by a physical examination.

2. **Diffusion and Rupture** result from yielding of the walls of an aneurism, as an outcome of some mechanical injury or from simple over-distension.

When an **internal** aneurism gives way, the patient usually experiences a sensation of pain in the part, and becomes pale, cold, and faint, possibly dying within a few minutes or, at most, hours; or there may be a sudden gush of blood from the mouth if the trachea or œsophagus has been opened. Sometimes internal aneurisms leak slowly, and the final stage lasts some days.

When an **external** aneurism yields, it may do so slowly or quickly. If the blood becomes effused *slowly* (constituting what is sometimes called a *leaking aneurism*), the tumour gradually increases in size, and its outline is less clearly limited; the pulsation diminishes in force and distinctness, and the signs of pressure upon the veins or nerves become more urgent, until gangrene sometimes supervenes. If the

aneurism ruptures *suddenly*, the patient experiences severe pain in the part, which becomes tense, swollen, and brawny; all pulsation ceases, both in the aneurism and below it, and gangrene of the limb follows, or even death from syncope, arising from the amount of blood extravasated, either externally if the skin gives way, or into the tissues and under the fasciæ. Suppuration may also occur in these cases, the skin becoming red and inflamed, and finally external rupture may follow. In the absence of history the recognition of diffuse aneurisms is by no means simple, especially when they become inflamed, and then only the most careful attention to the facts to be made out by digital examination can determine the nature of the case.

3. **Suppuration** is an exceedingly serious, but by no means a usual, complication. It may arise in the following ways: (*a*) After ligature of the main vessel, especially when the wound becomes septic, and there is a good deal of loose cellular tissue around the sac, as in the axilla; (*b*) after diffusion, partial or complete, of an aneurism, where there is great tension upon surrounding parts. Auto-infection or the presence of an infective embolus may finally determine the suppurative process. The tumour shows signs of inflammation, becoming hot, red, painful, and swollen, and the skin over it may pit on pressure; whilst fever and general constitutional disturbance are also present. Sooner or later, if left to itself, the tumour points at one spot and bursts, giving exit to a mixture of blood-clot, pus, and a greater or less amount of bright red blood. The patient either dies at once from syncope, or a little later from secondary haemorrhage and septic poisoning, unless efficient treatment is adopted. Occasionally, but very rarely, the afferent trunk becomes plugged by a thrombus, and spontaneous cure may thereby be induced.

Treatment of Aneurisms.

1. **General Treatment** is employed as an accessory to surgical measures, or must be depended on entirely in cases were local means are impracticable or contra-indicated, such as in internal aneurisms; it is then to be looked on rather as palliative in nature than curative. The general condition of the patient must be carefully investigated, since aneurisms are associated either with plethora or with an enfeebled and cachectic state of the system.

In *plethoric* individuals, where the disease often runs a rapid course, absolute rest, both mental and physical, must be enjoined, with the removal of all sources of irritation and worry. The bowels are freely opened by a calomel purge at the commencement of treatment, and watery stools should be subsequently induced by 20-grain doses of pulv. jalapæ co. two or three times a week, so as to increase the plasticity of the blood. The heart's impulse may be diminished by the use of aconite, or even by venesection when it is very forcible. Iodide of potassium is useful both for reducing blood-pressure and in cases where a syphilitic history is

present. The diet must be diminished, all stimulating articles being eliminated, and only highly nutritious material allowed, and that mainly of the nitrogenous type, with as little fluid as possible. Various special methods, *e.g.*, Tufnell's, Valsalva's, etc., have been recommended, but it usually suffices to limit the dietary as much as is in conformity with the patient's comfort and well-being, and not to allow more than about a pint of fluid in the day.

In *weakly individuals*, whilst enjoining strictly a recumbent posture, the surgeon should prescribe iron and a somewhat more liberal diet, in order to improve the quality of the blood.

II. **Surgical Treatment.**—Whichever of the plans described below is selected in any particular case, the general health must be carefully attended to, and the condition of internal organs fully investigated beforehand, as great harm may follow injudicious interference, if internal aneurisms co-exist.

A. The ideal treatment consists in so dealing with the arterial wall as to obliterate the aneurism, but without occluding the original lumen of the vessel. This is possible in a few selected cases of sacculated aneurism, and a method of *Arteriorrhaphy* has been suggested and practised by Matas* of New Orleans for this purpose, in which the aneurismal wall is sutured up into pleats. Further experience is required before any definite opinion can be given as to its practicability or value.

B. **Complete Extirpation** of the aneurismal sac may be looked on as the best and most satisfactory method of treatment in the majority of cases. The sac is thus dealt with as if it were a tumour, although, owing to the adhesions always present, complete separation of the wall from surrounding parts is often difficult. The limb is exsanguinated by elevation, and in suitable cases the aneurism is removed without opening it, and the vessel secured by ligature above and below, as also any branches which may arise from it. When, however, a large saccule obscures the main trunk, it may be necessary to open it and turn out its contents before attempting its extirpation. Not unfrequently the vein will be encroached on in this dissection, and it may have to be removed; bad results are not likely to follow, since probably its lumen has been already diminished by the pressure of the sac, and an efficient collateral venous circulation established. This method has hitherto been chiefly applied to small aneurisms of the peripheral vessels, and, indeed, in the majority of such cases no other plan need be considered; surgeons are now, however, extending its scope to the larger trunks, such as the popliteal, carotid, external iliac, and subclavian, from each of which aneurisms have been successfully extirpated, whilst as far back as 1883 one of us removed in this way a recurrent femoral aneurism, involving the vein, with a good result.† It is also attempted as an alternative to amputation for recurrent, diffused, and suppurating aneurisms. The results of this operation which have been recently recorded are most encouraging:

* *Annals of Surgery*, February, 1903.

† *Lancet*, 1883, ii., p. 1082.

primary union of the wound is often obtained, and hence the length of treatment is curtailed, whilst all chances of recurrence are removed. Statistics also show that there is less danger of gangrene, and this depends, as Pearce Gould has pointed out, on the fact that only one set of collateral circulation is called upon, viz., that required to bridge the gap made by removing the aneurism, whereas in the Hunterian operation a double set is needed, viz., at the site of the ligature, and round the consolidated aneurism. It is obvious that the nutrition of the limb is best secured when what Gould calls the 'irreducible minimum' of operative treatment, viz., the occlusion of the vessel only at the site of the aneurism, is undertaken. Secondary hæmorrhage is also less likely to occur.

C. The *deposit within the sac of fibrin*, which shall subsequently organize and thus lead to the obliteration of both sac and supplying vessel, was the ideal aimed at by the earlier surgeons, and has still to be relied on in many cases. It is obvious that a slow and gradual deposit of laminated fibrin is likely to be more satisfactory than the sudden distension of the sac with soft red clot.

The various plans adopted with this end in view are as follows:

1. **Compression** of the main vessels, usually on the proximal side of the aneurism, was much vaunted by the Dublin school of surgeons in the last century, and gave not a few good results. It may be applied either continuously or at intervals. If *intermittent*, the main vessel leading to the aneurism is controlled by means of fingers (digital compression), or by mechanical contrivances (such as a tourniquet or a conical bag filled with shot), for as long a period as the patient can bear, which usually does not exceed thirty minutes, especially if there is any nerve in the immediate neighbourhood. There seems to be no necessity to completely arrest the flow of blood through the sac, so long as the blood-pressure is sufficiently diminished to permit of coagulation within it. *Continuous* pressure can, as a rule, only be maintained under an anæsthetic, and in such cases the circulation through the sac is entirely stopped, so as to allow not only of its contraction, but also in some instances of the rapid coagulation of its contents. Such pressure may be effected by the fingers of relays of dressers, taking shifts of ten to fifteen minutes at a time; but inasmuch as its effective maintenance is excessively tiring and difficult, arrangements should be made whereby some weight, such as a conical shot-bag, rests upon the thumb or finger employed, thereby relieving muscular strain. Tourniquets may be similarly utilized, but are less satisfactory, since they require more skilful and accurate adaptation, and are liable not only to slip out of place, but also to bruise the coats of the vessels.

Although in suitable cases compression certainly has been successful, and may be given a trial before ligature, yet it is unwise to persevere with it for too long if signs of improvement are not quickly observed, lest the collateral circulation be increased to an undesirable extent, and the success of the subsequent operation jeopardized. Especially is this the case in plethoric individuals with high arterial tension. On

the other hand, in feeble, weakly patients, where gangrene of the limb might be anticipated, the opening up of the collateral circulation by compression, even if the aneurism is not thereby cured, is by no means a disadvantage.

Necessarily, the part of the skin to which pressure is applied must be carefully protected from local irritation by shaving and removal of hairs, by the use of dry aseptic dusting-powders, and by the surface of any pad employed being perfectly smooth, and the skin not wrinkled beneath it.

2. **Ligature** of the main vessels leading to or coming from the aneurismal sac must next be considered. The oldest procedure, the **Operation of Antyllus**, consisted in laying open the sac, turning out the clots, securing the vessel above and below, and allowing the wound to heal by granulation (Fig. 87, A). Performed, as it was originally, without anæsthetics or antiseptics, it was naturally attended with great mortality, since, even if secondary hæmorrhage did not occur from the main trunk, it was liable to follow from any of the branches which arose from the dilated portion of the vessel.

In **Anel's Method** (Fig. 87, B) the artery was tied just above the sac on the cardiac side, with no branch intervening; this also proved dangerous, since secondary hæmorrhage frequently resulted, either from suppuration within the sac, or from injury to the sac during the operation, or from yielding of the arterial wall at the site of ligature from septic peri-arteritis.

Hunter's Operation (Fig. 87, C), which consists of ligature of the main vessel on the cardiac side at some distance from the aneurism, was first performed by him in 1785. The object to be attained is not to cut off absolutely the blood-supply to the sac, but to allow the blood to enter it with a greatly diminished impulse, and in small amount at first, thus permitting of the contraction of the sac wall and of the gradual deposit of fibrinous clot within it. The sac thus becomes consolidated, and finally transformed into a mass of firm fibroid tissue. The operation is most likely to succeed in cases where the aneurism is well defined and not large enough to exercise injurious pressure on surrounding parts, whilst it is desirable, though not essential, that no branch of large size should intervene between the point of ligature and the sac. The operation is *contra-indicated* (1) in cases where serious cardiac disease co-exists, or when an internal aneurism is also present, rendering undesirable any sudden increase of the blood-pressure, as by occlusion of a main vessel; (2) where pressure over the vessel does not control the circulation through the sac; (3) where the peripheral vessels are extensively calcified; (4) where gangrene of the limb is threatening or present; or (5) where bones or joints have been seriously involved.

Distal Ligature is only practised for aneurisms situated in positions where it is impracticable to deal with the artery on the cardiac side of the sac, such as the innominate, lower part of the carotid, or first part of the subclavian. **Brasdor's Operation** consists in tying the main trunk beyond the sac, so as totally to cut off the circulation

through it (Fig. 87, D). In **Wardrop's Operation** a ligature is placed on one or more of the distal branches (Fig. 87, E). In the former the sac gradually contracts, and thus allows of the deposit of fibrin; in the latter proceeding, where the circulation is only partially controlled, the diminution of the size of the aneurism goes on much more slowly, and the chances of the deposition of clot in the sac are correspondingly lessened.

It is not unusual, after the application of a ligature to a main artery for aneurism, to observe a **return of pulsation in the sac** after a few days. In the majority of cases this only continues for a short time, and is by no means an unfavourable sign, indicating the re-establishment of the collateral circulation; but if it commences a week or ten days after the operation, it is more likely to persist. It is most frequently seen in cases where the main vessel has been tied at some

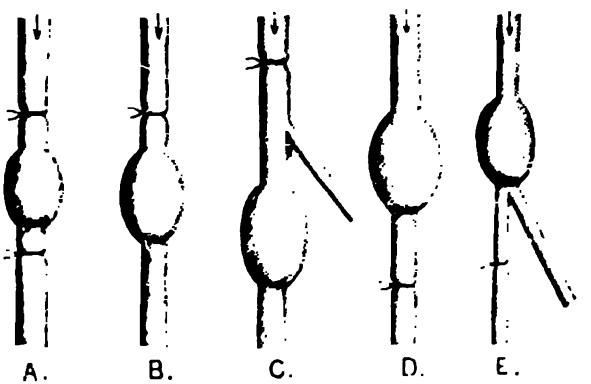


FIG. 87.—METHODS OF APPLYING LIGATURES FOR ANEURISM.
A, Method of Antyllus; B, Anel's operation; C, the Hunterian operation; D, Brasdor's operation; E, Wardrop's method.

distance from the sac, as in the superficial femoral for popliteal aneurism, and where one or more large and important collateral branches carry blood into the artery below the ligature or directly into the sac. The early recurrence of pulsation needs no *treatment* in most instances, since it disappears spontaneously; but when it comes on at a later stage, it demands serious attention. Rest, elevation of the limb, and judicious pressure over the trunk above the site of ligature, should first be tried. These failing, the following courses are open: (*a*) The artery may be again tied, either nearer the sac when feasible, or further away from it; (*b*) where the aneurism can be reached, it may be cut down on and dissected out, the best course to adopt if it be practicable; or (*c*) amputation just above the aneurism may be called for as a last resource, when the tumour is rapidly increasing or threatening to become diffuse, or if gangrene is impending.

3. **Electrolysis** has been occasionally employed in dealing with

thoracic aneurisms when a saccule has developed in an accessible position. The clot, however, is soft and liable to break up, and the results have not been very satisfactory. For details of the methods of employing electrolysis, see p. 353.

4. **The Introduction of Foreign Bodies into the Sac** (***Moore's Method***) has not been followed by much success, although a few cases of abdominal aneurism seem to have derived temporary benefit from it. Steel wire has been usually employed; it is firmly wound round a cotton reel to give it a spiral coil, and inserted into the sac through a very fine cannula. Varying lengths from 10 feet to 26 yards have been introduced.

5. The combination of the last two methods (as originally suggested and practised by an Italian, Corradi, in 1879) has been attended by some very happy results, especially in the hands of Stewart of Philadelphia.* He introduces a variable length of gold or silver wire (No. 30 gauge), preferably the former, through a small cannula, and then performs electrolysis through the wire which is attached to the positive electrode, whilst the negative electrode is placed on the back. The current is gradually increased up to 60 or 80 milliampères, and the whole proceeding lasts about thirty minutes. Finally, the wire is cut short and pushed into the sac. Several most brilliant results have followed this plan of treatment, including the cure of an innominate aneurism, the patient living for three and a half years, and of an aneurism of the abdominal aorta, dealt with by transperitoneal operation. We ourselves have treated a subclavian aneurism in this way with considerable temporary benefit.

An ingenious contrivance has been designed by Messrs. D'Arcy Power and Colt for this purpose. It consists of a fine wire wisp or cage, which can be introduced closed up as a cartridge into a special trocar, and pushed by a ramrod into the sac, where it expands of itself umbrella-fashion, thereby exposing a large surface of wire on which coagulation can occur; it is also arranged for electrolysis. Satisfactory results have attended its employment.

D. Quite distinct in principle from the preceding plans is that associated with the name of Sir William Macewen, who looks on blood-clot as undesirable material to work with for the cure of an aneurism, and directs his attention to thickening the walls of the sac to such an extent as to determine its occlusion, or to prevent its subsequent dilatation. To this end he employs **Acupuncture**, introducing several fine needles into the sac and leaving them to be played upon for a time by the blood-stream, so as to scratch and irritate the further wall of the sac, and thus cause an inflammatory hyperplasia, which shall subsequently organize into dense fibro-cicatricial tissue. The process must be repeated as often as is considered necessary. In his own hands excellent results have been obtained; but whilst admitting its value for internal aneurisms, we cannot but think that for those involving peripheral vessels other methods would be more rapid and equally effective.

* *British Medical Journal*, August 14, 1897; *Philadelphia Medical Journal*, June 25, 1898.

rarely reaches a great size, especially if it is intrapericardial, the sac usually rupturing before marked pressure signs are evident.

(2) When arising from the *transverse part of the arch*, the symptoms vary with the direction taken by the enlargement. If it projects *upwards*, a pulsating tumour may appear at the episternal notch, and cerebral effects may then ensue from interference with the circulation through the carotids, or from pressure on the venous trunks. If it extends *anteriorly*, it may form a large tumour with comparatively slight pressure effects, except the pain arising from its erosion of the thoracic wall; it then appears as a pulsating swelling to the right of the sternum. If the enlargement takes place either *posteriorly* or *downwards* within the concavity of the arch, symptoms in the shape of dyspnœa and dysphagia are early produced from the close contiguity of the trachea, œsophagus, and pulmonary vessels. Dyspnœa may also be due to pressure upon the left recurrent laryngeal nerve, causing paresis of the crico-arytenoideus posticus muscle and difficulty in opening the glottis; the voice, moreover, becomes harsh and the cough hard, with what has been described as a 'metallic ring' about it, which is extremely characteristic. Laryngeal or tracheal stridor may be noticed in these cases, and a dragging of the trachea synchronous with the heart's action (the so-called 'tracheal tug').

(3) Aneurisms of the *descending arch and thoracic aorta* often attain considerable dimensions, and may project posteriorly to the left of the vertebral column, causing a pulsating swelling. The only prominent symptoms are pain, due to erosion of ribs or vertebræ, and interference with deglutition, which may be so great as to suggest the presence of an œsophageal constriction; in fact, before a bougie is passed in any case of dysphagia it is always advisable to make certain, if possible, that an aneurism is not present. Auscultation in the left vertebral groove may reveal the existence of a systolic bruit where such a condition exists.

Treatment.—Little can be done beyond ordinary medical measures, such as rest, diet, and the administration of iodide of potassium. When the tumour could be felt in front, the introduction of coils of iron wire or horsehair has been attempted, and in one or two cases with partial or temporary success; whilst Stewart's method of electrolysis and Macewen's plan of acupuncture have been used with some benefit for supposed cases of sacculated aneurism. Dyspnœa may be at times severe, but *tracheotomy* should never be undertaken, death seldom resulting from this cause.

Surgical treatment, such as *ligature of the right carotid and right subclavian*, or of the left carotid alone, has been adopted in cases of aneurism of the ascending aorta or of the arch. A certain amount of improvement has followed some of the operations, but of eleven cases reported by Küster, five died within the first ten days. The principles underlying such proceedings are certainly at variance with those guiding our usual treatment of an aneurism, and it is quite possible that the improvement was as much due to the

enforced rest in bed as to the operation. Of course, if the lower end of the carotid is involved in the aneurismal swelling, distal ligature may do some good, as in a case of our own,* where the left carotid and subclavian were tied, with a short interval between the operations. The patient's condition improved greatly for a time, and she was able to return to work, but the aneurism finally burst into the left pleura about three years after the first operation.

Innominate Aneurism is usually of the tubular variety, and frequently associated with a similar enlargement of the aorta. It presents a pulsating tumour behind the right sterno-clavicular articulation—*i.e.*, between the heads of origin of the sterno-mastoid—projecting either into the episternal notch or outwards into the subclavian triangle, and perhaps pushing the clavicle forwards. The effects produced by its pressure are very variable. The *pulse* in both the right temporal and radial arteries is diminished; *œdema* of a brawny character of the right side of the head and neck, and of the right arm, is caused by pressure on the right innominate vein, whilst less commonly similar changes on the left side may follow compression of the left vein or of the superior vena cava; *pain* shooting into the neck and arm is often produced by implication of the cervical and brachial nerves, whilst hyperæmia of the right side of the face and dilatation of the right pupil may result from irritation of the sympathetic trunk. *Dyspnœa* is induced by direct pressure on the trachea, which may be displaced or flattened, or by irritation of the right recurrent laryngeal nerve, causing partial or complete paralysis of the right vocal cord. *Dysphagia* occurs from pressure on the œsophagus.

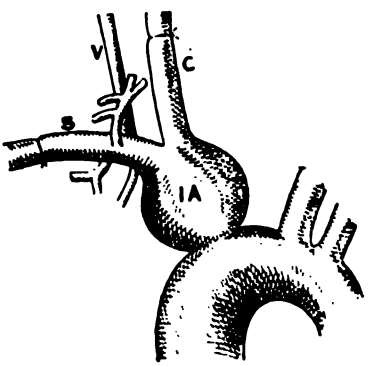


FIG. 88.—APPLICATION OF LIGATURES FOR INNOMINATE ANEURISM. (AFTER ERICHSEN.)

IA, Innominate aneurism; S, subclavian artery; C, carotid; V, vertebral artery.

The course of the case is slowly progressive, and death most commonly results from asphyxia or from rupture of the sac.

Treatment.—Rest and the administration of large doses of iodide of potassium may cause improvement, but distal ligature is the most hopeful proceeding. It is obviously impossible to cut off all the blood passing through the sac to the three main divisions—viz., the carotid, subclavian, and vertebral—with safety to the patient (Fig. 88). Ligature of any one of these by itself offers but little prospect of improvement; thus, the only case benefited by ligature of the subclavian was

* *British Medical Journal*, December 3, 1898

one treated by Wardrop, in which the carotid also had been independently and by accident blocked; whilst the only cure recorded after tying the carotid was probably due to subsequent suppuration within the sac (Evans). Ligature of both carotid and subclavian, with an interval of more than a week between the two operations, has practically the same effect as a single ligature, for by that time the collateral circulation will have been established. The results following such practice are better than those gained by ligating a single vessel, but not so good as those from tying both vessels at the same time. Simultaneous ligature is doubtless the best plan of treatment to adopt; it places the sac in the best possible condition for the deposit of fibrin, whilst the additional step of tying the third part of the subclavian does not materially add to the risk of the operation, which is mainly due to the effect on the cerebral circulation. Should operative measures seem undesirable, recourse must be had to Stewart's or Macewen's methods.

Aneurism of the Common Carotid is usually situated at the upper part of the trunk near the bifurcation, and more often on the right than on the left side. The root of the right carotid as it springs from the innominate is also not unfrequently dilated, but the intrathoracic portion of the left carotid is rarely affected, except in conjunction with aneurism of the aorta. No other external vessel is so frequently the seat of aneurism in women.

The ordinary intrinsic *signs* of an aneurism are present, and the pressure symptoms are mainly referable to interference with the cerebral circulation, to irritation of the cervical sympathetic trunk, or to pressure upon the larynx, pharynx, or trachea. The progress of these cases is usually slow.

Diagnosis.—(1) *From similar disease at the root of the neck* the distinction is often made with difficulty, since either an aortic, innominate, or subclavian aneurism may push upwards so as to simulate it somewhat closely. Percussion and auscultation of the upper part of the chest, together with a careful investigation into the history of the case, and a digital examination of the limits of the pulsating mass, may suffice to determine the point. Holmes suggests trying the effect of carefully applied distal pressure for a few hours; in a carotid aneurism the tension becomes distinctly less as the collateral circulation commences to enlarge, whilst in an aortic aneurism no difference is observed. The *pressure effects* must also be carefully considered. 'Pressure on the left recurrent laryngeal nerve would distinguish an aortic aneurism from one on the right vessels; pressure on the right nerve in like manner excludes an aortic aneurism. Pressure on the left innominate vein indicates aortic aneurism rather than innominate; compression of the internal jugular or subclavian vein only points to carotid or subclavian aneurism. A "tracheal tug" indicates an aneurism of the aorta' (P. Gould). The differences in the *peripheral pulses* may also give useful information. The two radial pulses should be first examined;

if they are equally affected, an aneurism of the aorta on the cardiac side of the innominate is indicated; if they are equal and normal, an aneurism on the distal side of the origin of the left subclavian. If the left radial pulse is alone aneurismal, the root of the left subclavian is diseased, whilst if the left temporal is also affected, it suggests an aneurism of the transverse part of the arch beyond the innominate. When both radial and temporal vessels on the right side show signs of interference with the pulse, innominate aneurism is probably present, whilst an affection of only one of these branches indicates that the corresponding carotid or subclavian is dilated. One source of fallacy must not be forgotten, viz., that any one of these trunks may be occluded or compressed by a neighbouring aneurism without being dilated, and hence the quality of the pulse must be taken into consideration rather than its actual volume, and to this end the sphygmograph is a useful adjunct in diagnosis. (2) From *abscess, tumours, or enlarged glands* with a transmitted impulse, a carotid aneurism is recognised by an application of the general principles detailed above (p. 307). (3) *Pulsating or cystic goitre* may be distinguished from a carotid aneurism by noting that the goitre is not, as a rule, limited to one side of the neck, the isthmus being also involved; that the most fixed part of the tumour is in the median line, and not under the sterno-mastoid muscle; and that the swelling moves up and down during deglutition, an aneurism remaining fixed. (4) An aneurism close to the bifurcation may be simulated by an *abnormal arrangement of the terminal branches*, the external carotid crossing the internal from behind forwards, and being pushed outwards sufficiently to cause a pulsating swelling beneath the skin. This condition is usually symmetrical, and can be recognised by careful palpation.

Treatment.—*Ligature* of the carotid above or below the omohyoid is the treatment usually adopted, and generally with great success. If the aneurism is near the root of the neck, proximal ligature becomes impracticable, and the distal operation (Brasdor's) must be undertaken.

Aneurism of the External Carotid is seldom met with, except as an extension of one involving the bifurcation. The usual phenomena are presented near the angle of the jaw, and well above the thyroid cartilage. Pressure results are early experienced, *e.g.*, paralysis of one side of the tongue through implication of the hypoglossal nerve, aphonia, or dysphagia. In suitable cases, the sac may be dissected out after securing the branches arising from it, as recommended by the late Mr. Walsham.* Failing this, the common trunk must be tied.

Aneurism of the Internal Carotid (extracranial portion) presents symptoms which closely resemble those caused by an aneurism of the bifurcation or of the external carotid, except that the swelling projects more into the pharynx, from which it is separated merely by the pharyngeal wall. It appears as a tense pulsating tumour,

* *Trans. Med. Chir. Soc.*, February 28, 1899.

placed immediately under the mucous membrane, and looking dangerously like an abscess of the tonsil. The **Treatment** consists in tying the common carotid.

Intracranial Aneurism.—Any of the arteries within the skull may become the site of an aneurism, but this condition occurs more commonly upon the internal carotid and its branches than upon those arising from the vertebrals, although the basilar artery is more often affected than any other single vessel. The aneurisms are generally fusiform in character, and their origin is often extremely obscure, a blow or fall being sometimes adduced to explain them; in children they are stated to result from the lodgment of septic emboli. They sometimes grow to a considerable size before causing obvious symptoms; the patient may, in fact, have continued without any manifestation of the disease, until suddenly seized with a rapidly fatal apoplexy from rupture of the sac. If there are any symptoms, they are due rather to compression of the brain than to erosion of the more resistant bony structures. Pain which is more or less fixed and continuous may be complained of, or there may be a feeling of pulsation, or of opening and shutting the top of the skull. Sight, hearing, and other functions of the brain, may also be interfered with, but physical changes in the eyes, such as optic neuritis or atrophy, are not induced, unless there is direct pressure on some part of the optic tract. Occasionally a loud whizzing bruit may be heard on auscultating the skull. The only **Treatment** possible, if a diagnosis can be established, is ligature of the common carotid artery, and even this will be of little use if the basilar is affected.

An **Intra-orbital Aneurism** is recognised by the existence of a pulsating swelling of the orbit, causing protrusion of the eyeball (exophthalmos) and congestion of the conjunctival and deeper vessels. A feeling of pain or tension in the orbit may exist, and gradually vision is impaired, whilst the cornea may become opaque from exposure, due to the inability of the lids to cover it; finally, the whole globe may be disorganized. The symptoms sometimes commence with a definite snap or crack, as though something had given way in the orbit; or they may follow a penetrating injury or a blow. Occasionally the condition is congenital, or arises soon after birth.

Several pathological lesions are included under the title 'intra-orbital aneurism': (*a*) If congenital, it is probably a case of aneurism by anastomosis: this, however, is not common, being present only in two out of seventy-three cases collected by Rivington; (*b*) if traumatic in origin, whether due to a penetrating injury or not, the case is probably an aneurismal varix between the internal carotid and cavernous sinus, or a genuine traumatic aneurism of the ophthalmic artery; (*c*) if idiopathic, it is possibly due to thrombosis of the cavernous sinus, or to spontaneous aneurism of the internal carotid or ophthalmic arteries.

Diagnosis.—Sarcomata are occasionally met with exhibiting many of the characters of intra-orbital aneurism. Careful palpation will,

however, generally demonstrate the existence of a more definite tumour, and a less-marked expansile pulsation in the sarcoma, whilst the bruit is less distinct. The distortion of the eyeball and ocular axis is often considerable in malignant tumours, but vision is not so early affected.

Treatment. Electrolysis and ligature of the common carotid are the only means which hold out any prospect of success, and of these the former should always be first tried. In the congenital cases its application has been very successful, but in those due to trauma it is very likely to fail.

Subclavian Aneurism is most frequently seen in men, and particularly those who use their arms much in lifting, such as soldiers and sailors; the right vessel is more often affected than the left. Any part of the artery may be involved, but the greatest dilatation naturally occurs in the third portion. A pulsating tumour develops in the subclavian triangle, which may reach above the clavicle, but chiefly extends backwards, outwards, and downwards, causing pressure effects upon the veins and nerves of the arm, and also cough by irritation of the phrenic. Occasionally it encroaches on the dome of the pleura and apex of the lung, and has been known to burst into the pleural cavity. It does not increase in size very rapidly, being surrounded by dense unyielding structures, and never compresses the trachea or œsophagus.

No difficulty presents itself in **Diagnosis** as a rule, although in the early stages it may be somewhat simulated by a normal artery pushed forwards by an exostosis of the first rib, or by a supernumerary cervical rib. A pulsating sarcoma growing from any of the neighbouring structures may also resemble it somewhat closely, but the pulsation is then rarely so limited in extent as in an aneurism, and a definite tumour can usually be felt.

The **Treatment** of subclavian aneurism is surrounded with difficulties, and the results hitherto obtained have been most unsatisfactory. *Excision* has been undertaken in one case with success after turning up the middle third of the clavicle, but the aneurism is seldom sufficiently limited to allow of this proceeding. Should any dilated portion of the artery be available outside the thorax, *digital compression on the cardiac side* may be attempted. Direct pressure, manipulation, galvano-puncture, and needling the sac according to Macewen's method, have been adopted with occasional success, but cannot be relied on. Stewart's method proved of benefit in one of our cases, the aneurism becoming firmer, and the patient free from pain and able to return home. Unfortunately, he died three months later from hæmorrhage, but no post-mortem examination was obtainable. About 10 feet of gold wire were introduced. *Ligature of the innominate trunk* suggests itself as the operation to be adopted for cure by the Hunterian method, and recent records would certainly encourage one to repeat it in any suitable case, since most of the fatal results occurred prior to the introduction of antiseptic surgery.

* Moynihan, *Annals of Surgery*, July, 1898

death resulting from sepsis or secondary hæmorrhage. It would appear that the simultaneous ligature of the carotid or vertebral trunks with the innominate is essential to success, in order to prevent the rapid backflow on the distal side of the ligature which otherwise occurs; in addition, the coats of the vessel must be approximated by a broad animal ligature, *e.g.*, of gold-beater's skin, and not divided.

Ligature of the first part of the subclavian has also been attempted for the cure of aneurisms involving the lower part of the vessel, but until recently it was so uniformly fatal that it was considered quite an unjustifiable proceeding, the first nineteen cases all dying. Clutton,* however, has reported a successful case, the ligature being applied (without dividing the coats) on the proximal side of the thyroid axis and internal mammary vessels, which were also secured. The first part of the axillary and the superior intercostal had also to be tied before pulsation in the aneurism ceased. Halsted† has since reported a second successful case of this operation. *Ligature of the second part* of the subclavian has been advantageously employed in suitable cases where the aneurism was situated below it. *Distal ligature of the third part* has also been attempted, but without much success.

As a last resource, where the above measures are impracticable or have failed, the plan suggested by the late Sir William Fergusson may be followed, viz., *amputation at the shoulder-joint and distal ligature* as near the sac as possible. Distal ligature alone is usually unsuccessful, owing to the fact that the great bulk of the blood needed for the nutrition of the arm still passes through the sac, and there is no means of checking this except by the removal of the limb. A few successful results of such heroic treatment have been reported.

Axillary Aneurism is usually the result of falls on the outstretched arm, or injuries to the shoulder, such as fractures or dislocations, or of attempts to reduce them. The **Symptoms** are merely those due to the presence of a pulsating tumour and its pressure, which may cause pain, local and neuralgic, or œdema of the arm. When the upper part of the vessel is affected, a pulsating swelling is felt immediately below the clavicle, whilst if placed lower down it projects more into the axilla, and may totally fill up the hollow. Occasionally the clavicle is displaced upwards, or the aneurism may extend beneath it into the neck, conditions of serious import as regards treatment.

Treatment.—Compression (digital) or ligature of the third part of the subclavian artery is required, but if the aneurismal sac extends under the clavicle, it may be necessary to secure the second part of the artery, due care being taken of the phrenic nerve.

Aneurisms of the brachial artery, or of any of the vessels of the forearm, require no special notice. They are almost invariably traumatic in origin, and should be treated by extirpation.

Abdominal Aneurism.—The abdominal aorta may become the seat of aneurism, either at the upper part near the cœliac axis, or at the bifurcation; in the former case, some of the branches arising at this

* *Trans. Med. Chir. Soc.*, vol. lxxx., p. 391. † *Annals of Surgery*, May, 1900

spot are also usually involved, and the disease is of the sacculated type. Occasionally aneurisms form independently on the splenic or mesenteric vessels. A pulsating tumour is observed, usually near the middle line, and either close to the umbilicus or in the epigastric notch; the pulsation is expansile in type, and remains the same in character whatever the position of the patient. Pressure signs are mainly confined to pain, localized in the back from erosion of the vertebræ, or neuralgic from pressure on the solar plexus or lumbar nerves, whilst œdema of the lower extremities may arise from compression of the vena cava. There may be some concurrent derangement of the intestinal functions.

Diagnosis.—Many conditions give rise to epigastric pulsation, but the majority of them can be readily distinguished from abdominal aneurism by careful examination, if necessary, under an anæsthetic. Cardiac pulsations may be felt in the epigastrium when the heart is dilated, but should be easily recognised; as also an impulse transmitted from the aorta through a collection of fæces or a cancerous growth. The examination of such a case should be conducted not only in the dorsal decubitus, but also in the genu-pectoral position, so as to remove the weight of the viscera from the aorta, when the pulsation will cease or become much diminished. A large accumulation of abdominal fat will seriously interfere with any satisfactory investigation.

Treatment.—Ligature of the aorta even on the distal side has never yet been attempted for this condition, and hence, failing medical treatment by rest and diet, *compression* was formerly relied on, being applied either on the distal or proximal sides of the sac. The method is, however, clumsy and liable to bruise the abdominal viscera. More recently treatment by needling the sac has been employed, and certainly in Macewen's hands at least one case has been brilliantly successful. There is also one instance on record where the introduction of wire into the sac, combined with electrolysis, cured an aneurism as large as an orange; the abdomen was opened, and electrolysis was maintained for thirty-seven minutes.

Iliac or **Inguinal Aneurism** arises from either the common or external iliac, or from the common femoral; it is frequently sacculated in type, and certain sooner or later to become diffuse. Its shape is determined by the unequal pressure exercised by fascial or other structures, sometimes leading to lobulation. The symptoms are very typical, and pressure effects are mainly experienced in the veins and nerves of the leg. The **Diagnosis** cannot be well mistaken in the early stages, but later on, and specially when situated high in the iliac fossa, it may be difficult to distinguish from a pulsating sarcoma.

Treatment.—Proximal compression of the aorta or common iliac, where the situation of the swelling and the thickness of the abdominal parietes permit, has had a certain amount of success. It is carried out by means of a tourniquet, shot-bag, or the fingers, and may be advantageously combined with distal pressure. *Ligature of the*

external iliac has been frequently performed for inguinal aneurism, and with such success as to warrant its being employed in all suitable cases. *Ligature of the common iliac* is sometimes needed for aneurisms in the iliac fossa. The results of the retroperitoneal operation were by no means satisfactory, but the introduction of the transperitoneal method and the recognition of the importance of not dividing the inner and middle coats in such a large vessel, combined with the use of aseptic animal ligatures, are certain to lead to better results. In ten instances *ligature of the abdominal aorta* has been undertaken for iliac or inguinal aneurism, and in all a fatal issue followed, seven of the patients dying within forty-eight hours; one survived as long as the tenth day, and two lived for forty-eight and thirty-nine days respectively. Of course, wherever practicable, *extirpation* should be resorted to, and at least one successful case has been published.

Aneurisms of the Gluteal and Sciatic Arteries are usually traumatic in origin, and present as pulsating swellings of variable size in the buttock, the gluteal situated at the upper part of the sciatic notch, whilst the sciatic lies more deeply, and may be partly intrapelvic. Pulsation is well marked, and murmurs are heard on auscultation. Pain in the limb from pressure on the sciatic nerve is a prominent symptom, especially in the sciatic variety. The **Diagnosis** is by no means simple, especially from a pulsating sarcoma, and many mistakes have occurred even in the practice of eminent surgeons. **Treatment.**—The best results hitherto have followed laying open the sac, turning out the clot, and tying the affected trunk—a proceeding requiring operative dexterity and skill of the highest order. Ligature of the internal iliac has also been performed, and with a creditable degree of success, even where the old extraperitoneal method was employed. The use of the transperitoneal route greatly simplifies the operation, and the more recent records of this proceeding are most satisfactory. At the present time it should certainly be undertaken in preference to the plan of laying open the sac.

Femoral Aneurism is the title given to one forming in the course of the superficial femoral artery. It is not uncommonly tubular, and occurs almost invariably in males, and as often on one side of the body as the other. The **Diagnosis** needs no discussion, as the disease runs a typical course, and the **Treatment** consists either in extirpation, compression at the groin, or ligature of the common or superficial femoral trunk.

Aneurism of the Profunda Femoris Artery is a very rare condition, presenting the ordinary features of a pulsating tumour situated amongst the muscles on the inner side of the thigh, but causing no diminution of the pulse in the popliteal or tibial vessels. The superficial femoral may be felt coursing over it, but quite distinct. Compression by a shot-bag in the groin, or by a tourniquet, may be sufficient to effect a cure, whilst ligature of the common femoral or external iliac may be resorted to, if necessary.

Popliteal Aneurism (Fig. 89) occurs almost invariably in men, constituting a pulsating tumour in the ham, rendering the knee painful and stiff, and so much do the symptoms resemble those of chronic rheumatism that in every such case the popliteal space should be examined. The limb is usually semiflexed, and the aneurism, which is of a sacculated type, often increases rapidly in size. If the main swelling is situated to the front of the vessel, there is some likelihood of the knee-joint becoming implicated, and neighbouring bones carious; when it extends posteriorly, diffusion is not uncommonly followed by gangrene, on account of the pressure exercised, not only upon the vein, but also upon the articular branches of the popliteal artery, which are most important factors in maintaining the collateral circulation. The **Diagnosis** has to be made from chronic enlargement and abscess of the popliteal glands, but in these there is less disturbance of the circulation in the foot; from bursal tumours, by their want of mobility and pulsation; or from solid tumours, *e.g.*, pulsating sarcoma of the femur or tibia, from which it can be recognised by attention to the general principles already enunciated. In a few instances spontaneous cure has resulted from the pressure of the sac upon the artery above.

FIG. 89.—POPLITEAL ANEURISM.

Treatment.—Compression is eminently successful in many of these cases, whether applied in the groin or by Reid's method. Ligature of the femoral artery at the apex of Scarpa's triangle is, however, the plan most commonly adopted, and with the greatest success. In cases where either of these methods has failed, or where the aneurism has become diffuse or recurred, extirpation of the sac is the best course to adopt.

Ligature of Vessels.

Ligation in continuity is an operation performed to arrest the flow of blood to the periphery, in order either to check haemorrhage, or to promote the cure of an aneurism, or to diminish the rate of growth of some tumour, or to influence beneficially some peripheral organ by reducing its blood-supply, or as a preliminary to removing some vascular structure, such as the tongue.

The **Instruments** needed are as follows: scalpels, dissecting forceps, director or blunt dissector, forcipressure or artery forceps, blunt hooks, retractors for deep wounds, aneurism needle, ligature, needles, and sutures.

The **Material** to be employed for the ligature has been discussed elsewhere (p. 280). Sulphuro-chromicized catgut is that most

commonly employed for all but the largest trunks, and for its application to an artery in its continuity the following plan may be adopted: A fine loop of catgut having been passed under the vessel by means of an aneurism needle, a prepared ligature, consisting of three strands of catgut about 10 inches long, knotted together at each end, is threaded through the loop, which is then withdrawn, carrying the ligature under the vessel. The advantages of this method are, that the aneurism needle, being threaded with such fine gut, passes easily and without friction, whilst the use of the loop to draw the ligature back obviates the difficulty, where the artery is deeply placed, of threading the needle if passed unarmed, as is sometimes advised. The substitution of three strands for a single ligature distributes the pressure over a larger area, and is considered more certainly to effect occlusion.

As to the **Operation** itself, the strictest asepsis must be maintained. The artery is examined as far as is possible, so that a healthy portion may be selected for applying the ligature. The various structures met with on the way to the artery are recognised, and drawn, if need be, to one or the other side, so as to lay bare the sheath of the vessel. It is most important that these anatomical landmarks or *rallying-points* should each be seen or felt in order, so that the operator may not be led astray or miss the vessel. Naturally it is easier to find the artery in the living subject than in the dead, the pulsation being of the greatest assistance. The sheath, having been exposed, must now be opened over the situation of the artery by a few delicate strokes of the knife; a portion of the sheath should be picked up between the blades of the forceps, incised along the longitudinal axis, and stripped off the artery, taking care to keep the back of the knife towards the vessel. This incision should be about ¾ inch in length, and should open not only the general, but also the special, sheath of the artery, if such exist. The sheath is then steadied with forceps, whilst the aneurism needle is inserted unarmed, and gently manipulated up and down, so as to free the vessel all round, a matter of no great difficulty if the sheath has been sufficiently opened and the actual arterial wall fairly exposed. The ligature may then be passed through the eye of the needle, and carried round the vessel. It is tied in a direction exactly at right angles to the longitudinal axis, and in doing so the artery must not be dragged out of its sheath, but the ligature should be tightened by the tips of the forefingers meeting upon it. A reef knot is all that is necessary for security in the smaller vessels, but in the largest trunks it may be advisable to employ what has been termed the *stay knot*. Two strands of ligature material are passed round the vessel side by side and half knotted; the two ends on each side are then taken up together and tied across in one knot. The opening in the sheath may be closed over the ligature by a fine buried stitch, and the various structures displaced in reaching the vessel are similarly secured in good position.

The rule usually followed is to pass the needle *from importw*

structures, such as the vein, but really this is a matter of little importance when the above directions have been carefully carried out, and especially in superficial vessels. *Should the vein be accidentally punctured*, the needle must be at once withdrawn, and the puncture in the vein secured by ligature, whilst the artery is tied a little higher or lower. In dealing, however, with the smaller vessels, where the venæ comites are in close contact with the artery, no harm will attend their inclusion in the ligature.

After-Treatment.—The ordinary antiseptic precautions are taken in regard to the wound, which should be healed and all stitches removed in eight days; but the patient must be kept at rest for some time longer to allow the tissues to consolidate, especially in dealing with the larger vessels and in elderly people. When the main artery to one of the extremities has been tied, the limb should be wrapped in cotton-wool and slightly raised. If there is any likelihood of gangrene, as in the lower limbs of elderly people, the extremity should be thoroughly purified and wrapped in aseptic wool immediately after the operation, in order to avoid septic complications.

There are two great **dangers** liable to follow the ligation of an artery in its continuity:

1. **Secondary Hæmorrhage** (*vide* p. 280).

2. **Gangrene**, which may arise from a variety of causes: (*a*) From simple loss of vitality, owing to a defective collateral circulation, as when the peripheral vessels are calcareous and rigid. The tissues which receive the smallest amount of blood die first, *e.g.*, the fingers or toes, or the subcortical white substance of the brain. Severe loss of blood after the operation, as from secondary hæmorrhage, may also determine tissue necrosis. Under such circumstances it almost always takes on the dry form. (*b*) Interference with the venous return, as by injury to the vein during operation, or the pressure of a tight bandage, or thrombosis induced subsequently by septic periphlebitis, is very likely to cause gangrene, and then it is of the moist type. (*c*) Injudicious after-treatment, such as too great elevation of the limb, the application of cold lotions, an ice-bag, or fomentations during the period of diminished vitality immediately following the operation, or even an attack of erysipelas, may also bring about the death of some of the tissues.

As soon as there is any suspicion of its onset, the whole limb must be thoroughly purified, and subsequently maintained aseptic. The **Treatment** of aseptic gangrene following ligature is expectant in character, the parts being allowed to separate naturally. But if there is much pain, or any tendency to spread, or if septic mischief is present, giving rise to fever and general disturbance, it is wiser to remove the limb well above the line of demarcation.

The **Innominate Artery** has now been tied with success on at least six occasions out of a total of about thirty operations. An incision is made along the lower third of the anterior border of the sterno-mastoid, and is prolonged downwards to sweep over the upper edge of the episternal notch. The platysma and the

superficial and deep fasciæ are divided, and the anterior jugular vein secured if necessary between two ligatures; the sterno-mastoid is drawn outwards, and its inner tendinous fibres are divided, whilst the sterno-hyoid and -thyroid muscles are severed close to the sternum and drawn inwards. The carotid sheath is now laid bare and opened at its lower part, so as to expose the carotid artery and enable it to be tied, and by following this downwards the innominate trunk is reached. In some cases it may expedite matters to remove portions of the sternum and inner end of the clavicle. The right internal jugular and innominate veins lie to the outer side of the artery, but if much engorged may project over it, and must then be drawn aside by retractors, whilst the inferior thyroid plexus may course directly downwards to reach the left innominate vein, which crosses the vessel. To the outer or right side and behind the veins are placed the vagus nerve and pleural sac, and these must be carefully separated from the artery, whilst the needle is passed from without inwards, and from below upwards. A double-curved aneurism needle will probably be required to effect this. A broad animal ligature should be used for this vessel, and the inner and middle coats must not be divided.

Collateral Circulation.—Intracranial: Vertebrals and carotids in the circle of Willis.

Face and Neck: Branches of the two external carotids across middle line.

Trunk: First aortic intercostal *with* superior intercostal of subclavian; upper aortic intercostals *with* thoracic branches of axillary and intercostals of internal mammary; deep epigastric and phrenic *with* terminal divisions of internal mammary.

The **Carotid Artery** may be tied either above or below the level at which it is crossed by the anterior belly of the omo-hyoid. The line of the vessel is indicated by that drawn from the sterno-clavicular articulation to a point midway between the angle of the jaw and the tip of the mastoid process, the bifurcation being on a level with the upper border of the thyroid cartilage.

Ligature above the Omo-hyoid.—This operation is usually chosen, if practicable, since the vessel is here more superficial, the ligature being applied on a level with the cricoid cartilage. The patient lies upon the back, with the chin raised and the head turned a little towards the opposite side. A 3-inch incision is made in the line of the vessel, the centre on a level with the cricoid (Fig. 00, D). The skin, platysma, and fasciæ are divided, and the anterior edge of the sterno-mastoid defined as the first rallying-point. The deep fascia is incised along its inner border, so that it may be drawn aside by a retractor; the sterno-mastoid branch of the superior thyroid artery may be divided at this stage, and a vein passing between the facial and anterior jugular may also need to be ligatured. On the inner side of the wound the omo-hyoid muscle must now be looked for, trending forwards and upwards from under cover of the sterno-mastoid. In the angle formed by these two structures the pulsation of the vessel should be felt and the sheath readily recognised, with the descendens cervicis nerve upon it. It is opened on the inner side, and the artery well cleared. The needle is passed from without inwards, and if the sheath has been efficiently opened, the vagus nerve will run no risk of being included.

Ligature below the Omo-hyoid.—The incision is made in a similar direction to the above, but lower in the neck, reaching from the cricoid cartilage nearly to the sterno-clavicular joint. The sterno-mastoid is drawn outwards, and perhaps the anterior fibres may need to be divided; the sterno-hyoid and -thyroid muscles are retracted inwards or divided, and the omo-hyoid can usually be drawn upwards. The sheath is thus exposed, and opened on the inner side, the needle being passed as in the previous operation. It must be remembered that both internal jugular veins are directed towards the right side in the lower part of their course, and hence the left vein is likely to lie somewhat in front of the artery. The inferior thyroid veins may also be seen, and need to be drawn aside or ligatured.

The *effects* of ligature of the carotid upon the brain are of great interest and importance. Statistics go to prove that in about 25 per cent. of the patients operated on cerebral symptoms manifest themselves, either immediately in the form of syncope from cerebral anæmia, or in the course of a few days from

cerebral softening, causing paralysis on the opposite side of the body, and even death. A fatal issue is likely to result in about half the cases thus affected. Occasionally a somewhat acute form of congestion of the lungs follows ligature of the carotid within a few hours, possibly due to interference with the circulation in the medulla, or to irritation or injury to the vagus or sympathetics; it may run on to subacute inflammation, and is best remedied by free stimulation or venesection.

Collateral Circulation.—Intracranial: Circle of Willis.

Extracranial: Communications across the middle line of branches of the external carotids and vertebrals; inferior thyroid *with* the superior thyroid; profunda cervicis *with* princeps cervicis of occipital; superficial cervical *with* branches of occipital and vertebral.

Ligature of the Internal Carotid is rarely needed, but has been employed for hæmorrhage and traumatic aneurisms. The ligature is usually placed just above the bifurcation, and the operation is practically the same as for securing the common carotid, only at a higher level. An incision is made along the anterior border of the sterno-mastoid, its centre being opposite the great cornu of the hyoid bone; the muscle is pulled well backwards, and the posterior belly of the digastric is now seen and drawn up. The external carotid is carefully displaced forwards, and then the internal carotid in its sheath appears. The latter is opened, and the aneurism needle passed from the jugular vein.

The *Collateral Circulation* to the brain is maintained by the circle of Willis.

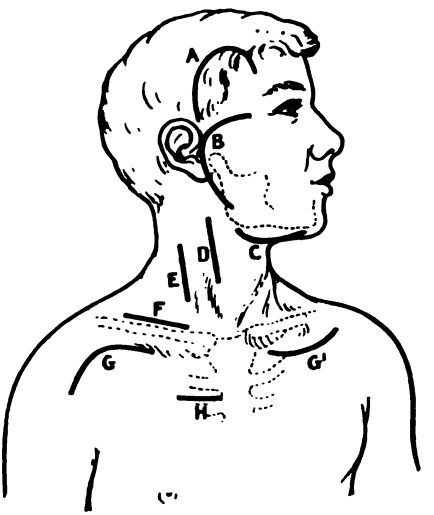


FIG. 90.—INCISIONS FOR VARIOUS OPERATIONS ON HEAD AND NECK.

A, Flap incision used in trephining for meningeal hæmorrhage; B, flap incision for operation on roots of the fifth nerve; C, incision for ligature of lingual artery; D, for ligature of common carotid; E, for ligature of vertebral artery; F, for ligature of the third part of the subclavian; G and G', incisions used for tying first part of axillary; H, for ligature of internal mammary artery.

Ligature of the External Carotid is occasionally required, the site of election for applying the ligature being between the superior thyroid and lingual branches. An incision is made along the anterior border of the sterno-mastoid, 3 inches in length, its centre corresponding to the great cornu of the hyoid bone. The edge of the muscle is defined and drawn outwards, and the posterior belly of the digastric sought for above, the hypoglossal nerve lying just below it. The sheath is now opened below the tip of the great cornu of the hyoid bone, and the needle passed from without inwards. The operation may be rendered exceedingly difficult by the presence of enlarged glands or veins, especially the lingual, facial, and superior thyroid, which often lie directly in front of the vessel. The superior laryngeal nerve is placed immediately behind it, and must necessarily be avoided.

Collateral Circulation.—Vide ligature of the common carotid (extracranial portion).

Ligature of the Lingual Artery is chiefly needed as a preliminary to removal of the organ for malignant disease; it is also occasionally employed in traumatic

cases. The vessel can be secured either close to its origin from the external carotid, or in the submaxillary triangle under cover of the hyoglossus muscle.

In the Submaxillary Triangle.—The patient lies on his back, with the shoulders raised, and the head extended backwards and turned to the opposite side. A crescentic incision is made, commencing about 1 inch below and external to the symphysis menti, and skirting the angle of the jaw, the centre opposite the great cornu of the hyoid bone (Fig. 90, C). The integument and platysma are divided, the lower border of the submaxillary gland is defined, and along it the deep fascia is incised. The gland is now drawn upwards, and held over the margin of the jaw with a retractor (Fig. 91, *Gs*). On thoroughly opening up the wound the two bellies of the digastric muscle (*M bir*) are seen converging to the hyoid bone (*Z*), the anterior belly passing superficial to the fibres of the mylo-hyoid muscle (*M mylo*), which course nearly transversely to the mandible, and of which the posterior fibres may be divided with advantage. The digastric tendon is drawn down with a blunt hook, and in the space thus cleared the hyoglossus muscle (*M hyogl*) becomes evident with its fibres passing vertically upwards, and resting upon it the hypoglossal nerve (5) coursing forwards to get under

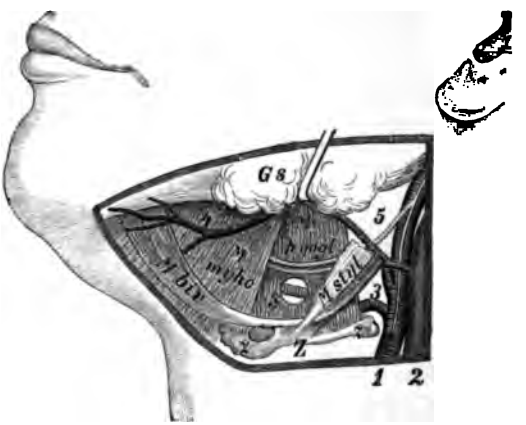


FIG. 91.—LIGATURE OF LINGUAL ARTERY. (TILLMANNS.)

The submaxillary gland (*Gs*) has been drawn over the side of the jaw with a hook; *Z*, hyoid bone; 1, external carotid; 2, internal jugular; 3, lingual artery; 4, ranine branch of facial; 5, hypoglossal nerve; *M bir*, digastric; *M styl*, stylo-hyoid; *M mylo*, mylo-hyoid; *M hyogl*, hyoglossus. The place where the artery is tied is indicated by a window in the hyoglossus, through which it can be seen.

cover of the mylo-hyoid, and either above or below it the ranine vein. The fibres of the hyoglossus are now divided transversely midway between the nerve and the hyoid bone, and in the opening made by their retraction is seen the artery (3), lying on the middle constrictor. Should it not be found in this situation, the incision in the hyoglossus should be extended backwards, and the vessel will then usually come in sight.

In the Neck close to its Origin.—An incision is made along the anterior border of the sterno-mastoid similar to that needed for ligature of the external carotid. The muscle is drawn backwards, and the great cornu of the hyoid bone defined. The small space is now cleared between that bony process and the posterior belly of the digastric, in which the artery can be felt resting upon the middle constrictor, and secured just as it rises from the external carotid.

The **Facial Artery** may be exposed and tied through a horizontal incision, 1 inch in length, made directly over the vessel as it crosses the lower border of the jaw immediately in front of the masseter. The platysma will need division, as well as the skin and fascia.

The **Temporal Artery** is reached in front of the auditory meatus, and as it crosses the zygoma, through a vertical incision. It is merely covered by skin and fascia, but must be carefully isolated from the auriculo-temporal nerve.

The **Occipital Artery** is tied through an incision extending from the apex of the mastoid process backwards for about 2 inches towards the occipital protuberance. The posterior fibres of the sterno-mastoid, the splenius, and trachelo-mastoid, are divided so as to expose the artery as it emerges from the groove on the under surface of the mastoid process, where it is easily secured.

The **Subclavian Artery** has been tied in each part of its course, but most frequently in the third. Ligatures of the first and second parts are such unusual proceedings that we must refer students to larger textbooks for descriptions.

Ligature of the third part is performed for axillary aneurism, for haemorrhage, as a distal operation for aortic or innominate aneurism, and sometimes as a preliminary to amputation of the upper extremity. The patient is placed on the back, close to the edge of the table ; the arm is well depressed, and the head turned to the opposite side. The skin is now drawn down by the left hand, and an incision 3 or 4 inches long made over the clavicle (Fig. 90, F). On releasing the skin it retracts upwards, so that the wound comes to be situated about ½ inch above the clavicle, and thus the external jugular vein is more efficiently protected. The incision should be placed with its centre about 1 inch to the inner side of the middle of the clavicle, and should expose the space between the sterno-mastoid and trapezius muscles, the fibres of which are divided to a suitable extent if they abnormally encroach upon the bone. The skin, superficial fascia, and nerves, with the platysma, are divided along the whole length of the incision, as also the deep fascia. The external jugular and other veins now come into view, often constituting a plexus, which may give the surgeon much trouble ; they are either drawn aside or, if necessary, divided between ligatures. The cellular tissue is then further incised in the line of the wound, care being taken to avoid the transverse cervical and suprascapular arteries, the former of which is above the line of operation, whilst the latter is hidden behind the clavicle and should not appear. The posterior belly of the omo-hyoid, if seen at all, is drawn upwards. Various layers of fascia must be carefully cut or torn through until the nerves of the brachial plexus appear ; the finger can then readily define the scalene tubercle on the first rib. The subclavian vein is situated in front of the finger, but on a lower level, whilst the artery itself can be detected pulsating under the pulp of the finger between it and the rib. The cords of the brachial plexus are placed above and external to it, the lower cord passing down behind. The needle is insinuated from above downwards, and must be kept very close to the artery to prevent all possibility of including the lowest cord of the plexus. The operation in a thin patient may be easy, but in a stout subject, with a short thick neck and high clavicle, the greatest difficulty may be experienced in finding the vessel. The chief dangers arise from wounding the aneurismal sac, the pleural cavity, or the superficial veins, whilst the proximity of the cords of the brachial plexus must not be forgotten.

Collateral Circulation.—*Thoracic set* : Branches of the aortic intercostals and internal mammary *with* thoracic branches of axillary.

Scapular set : Suprascapular and posterior scapular *with* subscapular and its dorsalis branch in the venter or on the dorsum of scapula.

Arterial set. Suprascapular *with* acromio-thoracic.

The **Internal Mammary Artery** (Fig. 90, H) may be exposed and tied by dividing the intercostal aponeurosis and muscles for an inch or more from the outer edge of the sternum, from which margin it is distant about ½ inch. If the vessel has been divided, and the ends have retracted, it may be necessary to excise a portion of costal cartilage in order to secure both ends—a most necessary proceeding, owing to the freedom of the collateral circulation and the consequent liability to continued hæmorrhage.

Ligature of the Vertebral Artery has been undertaken for wounds, for secondary hæmorrhage after ligature of the innominate, and in the treatment of epilepsy, but without much permanent benefit in the last case. The operation, though by no means easy, is usually successful as far as the immediate surgical procedure is concerned. An incision is made along the lower half of the posterior border of the sterno-mastoid (Fig. 90, E), the platysma and deep fascia are divided, a few of the posterior fibres of the muscle itself incised if need be, and its belly drawn well forwards. The scalenus anticus muscle is clearly defined, together with the phrenic nerve. The interval between it and the longus colli muscle can now be demonstrated, with the ascending cervical artery lying upon it. The anterior transverse process of the sixth cervical vertebra must be made out. Just below this the vertebral vessels are found entering the canal in the transverse process, and the vein, which is placed anteriorly, is drawn outwards to allow the needle to be passed from without inwards. A few sympathetic twigs are included in the ligature, and the resulting contraction of the pupil may (according to MacCormac) be looked upon as satisfactory evidence that the vertebral has been in reality secured.

Ligature of the Thyroid Vessels is sometimes used as a means of arresting the growth of a goitre.

The *superior thyroid artery* is tied through an incision along the anterior margin of the sterno mastoid, which has its centre opposite the upper border of the thyroid cartilage; the external carotid is defined, and the superior thyroid secured at its origin.

The *inferior thyroid artery* is reached through an incision along the inner border of the sterno-mastoid, extending upwards from the clavicle for 3 inches. This muscle and the subjacent carotid sheath are drawn outwards, the sterno-hyoid and -thyroid usually needing to be divided. The transverse process of the sixth cervical vertebra is sought for, and the vessel found passing inwards immediately below. It is taken up just behind the carotid, and as far from the recurrent laryngeal nerve as possible.

The **Axillary Artery** is tied for punctured wounds of the axilla, as a distal operation for subclavian aneurism, occasionally for wounds of the palmar arch, and possibly for secondary hæmorrhage from the brachial. Two classical operations are described and practised in classes on operative surgery.

1. *Ligature of the first part of the vessel* is usually undertaken through a curved incision, with its concavity upwards, extending from the coracoid process to within 1 inch of the sterno-clavicular joint, and ½ inch below the clavicle (Fig. 90, G[1]). The clavicular origin of the pectoralis major is divided, and the costo-coracoid membrane exposed, and divided along the lower border of the subclavius muscle. Branches of the acromio-thoracic axis are displaced downwards, and the main trunk is exposed by a blunt dissector and forceps. The vein lies within and below, and the cords of the brachial plexus above and to the outer side. The needle is passed from below upwards. The divided muscular fibres should be subsequently sutured together.

An incision which gives an unusually good approach and involves less division of muscular fibres is one which follows the lower border of the clavicle from its centre outwards to the coracoid process, and then turns down to lie over the interspace between the pectoralis major and deltoid muscles (Fig. 90, G). This intersection is opened up and the outermost fibres of the pectoralis which arise from the clavicle are divided. The costo-coracoid membrane is thus exposed, and the cephalic vein will act as a guide to the vessels.

2. *Ligature of the third part of the artery* is performed from the axilla. The arm is fully abducted, and the surgeon stands between it and the body. An incision is made in the course of the vessel at the junction of the anterior and middle thirds of the space between the axillary folds (Fig. 92, A). The inner border of the coraco-brachialis muscle is clearly defined, and forms the first rallying-point; it is drawn slightly outwards, and the median nerve, together with the musculo-cutaneous trunk, at once comes into view. On drawing these inwards, the artery itself is seen, with the vein to the inner side, togetherwith the internal cutaneous nerve. The needle is passed from the vein.

Collateral Circulation.—If above the acromio-thoracic, the same as for the third part of the subclavian (*q.v.*).

If above the subscapular and circumflex: Long thoracic and intercostals *with* thoracic branches of subscapular; suprascapular and posterior scapular *with* scapular branches of subscapular; supra-scapular and acromio-thoracic *with* posterior circumflex in the deltoid.

If below the circumflex, same as for ligature of brachial above the superior profunda—*i.e.*, posterior circumflex *with* superior profunda in the deltoid.

The **Brachial Artery** may need to be ligatured for hæmorrhage from the palmar arches, or from a wound in the forearm or about the elbow, for aneurisms, or for arterio-venous wounds at the bend of the elbow. It may be tied in one of two places:

1. *At the Middle of the Arm.*—The arm is held away from the side at a right angle, with the hand supine, but with no support beneath it, for fear of pushing forwards the triceps and displacing the vessel. The surgeon stands between the arm and the trunk. An incision 2 inches long is made in the line of the vessel along the inner border of the biceps muscle (Fig. 92, B), and the thin fascial investment of the limb divided. The inner edge of the muscle is clearly exposed, and by drawing it slightly forwards the median nerve is brought into view, and perhaps the basilic vein. The nerve, which is at this spot crossing the artery from without inwards, is drawn inwards, and the sheath of the vessel found beneath it. The artery is separated from its venæ comites, and the ligature passed and tied.

The operation is by no means always easy, as there are many traps into which the beginner may fall. Thus the median nerve may cross behind the vessel instead of in front of it; the basilic vein may lie over its situation, and be mistaken for it; or there may be a high division, and two trunks, usually lying close together, must then be sought for instead of one. The most common mistake consists in not defining the biceps muscle, and in seeking for the artery behind its proper situation.

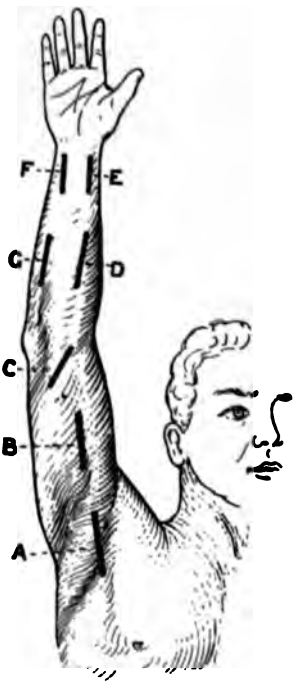


FIG. 92.—INCISIONS FOR TYING THE ARTERIES OF THE ARM.

A, Third part of the axillary; B, brachial; C, brachial at the bend of the elbow; D, middle third of radial; G, middle third of ulnar; E and F, lower thirds of radial and ulnar.

2. *At the Bend of the Elbow.*—An oblique incision is made, about 2 inches long, parallel to the inner border of the biceps tendon, its lower end corresponding to the crease of the elbow (Fig. 92, C). The incision should be placed at about an angle of forty-five degrees to the axis of the limb, and to the outside of, and nearly parallel to, the median basilic vein, which, if seen, must be drawn inwards. The bicipital fascia is now incised, and the artery with its venæ comites exposed in the loose fat, the median nerve being well away on the inner side. The needle is passed from within outwards.

Collateral Circulation.—If above the origin of the superior profunda, posterior circumflex in deltoid *with* ascending branches of superior profunda.

If below the origin of the inferior profunda, the anastomoses around the elbow-joint.

The Ulnar Artery rarely needs ligature except for palmar hæmorrhag direct wounds. In the former case the artery can easily be secured just a the wrist, in the latter case by enlarging the original wound. The follo stereotyped operations are described, but are more often seen in the examin room or dead-house than in the operating theatre. It should be borne in that the artery curves inwards from the centre of the bend of the elbow t radial side of the pisiform bone. The lower two-thirds of its course is cated by a line drawn from the internal condyle of the humerus to the spot below.

1. *At the Wrist.*—An incision about 1 inch in length is made directly up from the flexure of the wrist in the line of the vessel (Fig. 92, F). The fascia is opened, the tendon of the flexor carpi ulnaris drawn to the inner and the vessels are then seen, accompanied by the nerve which lies to the side of the artery. If possible, the venæ comites should be separated, an included in the ligature.

2. *In the Middle of the Forearm.*—An incision is made along a line drawn the anterior edge of the tip of the inner condyle to the radial side of the pis bone (Fig. 92, G). The white line indicating the intermuscular septum bet the flexor carpi ulnaris and flexor sublimis digitorum is then sought fo opened up ; it is often very slightly marked, and may be difficult to distin If the correct interspace has been opened, the surgeon is directed toward ulna, and readily finds the vessels under cover of the flexor carpi ulnaris, the nerve lying a little way to the inner or ulnar side. The most co mistake consists in getting too far to the radial side, and in separating v portions of the flexor sublimis, or in passing between it and the palmaris lo Occasionally, even when the correct interspace has been entered, a be may pass beyond the vessels, and find himself between the flexor carpi u and the flexor profundus.

3. The upper limit of the ulnar artery can be reached through an o incision along the upper border of the pronator teres, thus opening up the cubital fossa, and exposing the bifurcation of the brachial.

Radial Artery.—The line of the vessel extends from the middle of the b the elbow to the interspace at the wrist between the flexor carpi radialis a supinator longus. It then turns outwards, and may be felt beating in the described by French anatomists as 'la tabatière' (or snuff-box), betwe tendons of the extensor primi and extensor secundi internodii muscles.

1. *At the Back of the Wrist* the vessel may be secured by opening up the mentioned intertendinous hollow, where the artery is found coursing onwa the base of the first interosseous space. An oblique incision is made be the tendons, extending from the back of the styloid process of the radius base of the first metacarpal bone. The superficial radial vein is found b the skin, and a few twigs of the radial nerve. A deeper layer of fascia i divided, passing between the tendons, and beneath it the artery is e crossing the incision obliquely. The synovial sheaths accompanying the t should not be opened, or some limitation of the movements of the thum result.

2. *Above the Wrist* an incision is made in the line of the vessel (Fig. which is found after division of the fascia between the supinator long flexor carpi radialis. The radial nerve has passed to the dorsum ere this, any nerve filaments are seen they are derived from the external cutaneo small superficial vein usually lies over the artery.

3. *In the Middle or Upper Third of the Forearm* an incision is made in t of the vessel (Fig. 92, D), and the inner border of the supinator longus for and retracted. The vessels are found under cover of this structure, w radial nerve to the outer side, though separated by an interval above.

Ligature of the Abdominal Aorta* has been undertaken in fourteen in

* See *Tillaux* and *Riche*, *Revue de Chirurgie*, January, February, and 1901.

for severe primary or secondary hæmorrhage, or for diffuse inguinal or iliac aneurism, when no other method of treatment was practicable. All these cases have proved fatal, though one patient operated on by Monteiro in South America survived till the tenth day, whilst Keen's and Tillaux's lived forty-eight and thirty-nine days respectively. The fatal issue was in most instances due to septic contamination and secondary hæmorrhage, and as the operation has certainly been successful in animals, it is possible that we may yet be able to chronicle a successful result as a triumph of modern surgery.

Two distinct plans of operation have been followed, viz., the transperitoneal and the extra- or retro-peritoneal, but no one would attempt the latter nowadays. The *transperitoneal* operation consists in opening the abdomen through an incision slightly to the left of the middle line, having the umbilicus on a level with its centre. The intestines are retracted on either side, and the posterior layer of the serous membrane covering the aorta carefully divided; there is then no difficulty in passing a ligature around the vessel. Possibly it would be well to prevent excessive backflow of blood by securing one or both of the common iliac trunks in addition; such would in no way interfere with the collateral circulation.

The **Common Iliac Artery** extends for a distance of 2 inches from the bifurcation of the aorta opposite the left side of the body of the fourth lumbar vertebra to the front of the sacro-iliac synchondrosis. It may be reached in the same way as the aorta by two methods, the trans- and the retro-peritoneal.

In the *retroperitoneal* operation a curved incision (Fig. 93, A or B) is made through the abdominal parietes, somewhat similar to that for ligaturing the external iliac, but extending higher. The muscles and fascia transversalis are carefully divided, and the peritoneum, together with its contents, stripped up and held out of the way with a broad retractor. The ureter which crosses the artery is readily carried forwards with the peritoneum. The vessel is now sought for, carefully cleared, and a ligature passed from right to left (of the patient) on both sides of the body, the vein lying behind the artery on the right side, and behind and internal to it on the left.

The *transperitoneal* plan has already been undertaken with success, and will doubtless henceforth supersede all other methods. An incision is made in the median line with its centre a little below the umbilicus, the peritoneum opened, the intestines retracted, the vessel sought for and exposed by an incision through the posterior layer of the parietal peritoneum, and a ligature passed and tied. The ureter which crosses the artery just above its bifurcation must be carefully avoided.

Collateral Circulation.—Blood reaches the *external iliac* and its branches by means of the anastomoses of the lumbar arteries *with* the circumflex iliac, and of the superior epigastric, lumbars, and intercostals *with* the superficial and deep epigastric. The *internal iliac* and its branches are supplied by the union of (*a*) the lumbar branches *with* the ilio-lumbar; (*b*) the middle sacral *with* the lateral sacral; (*c*) the retropubic anastomosis of the two obturator arteries; and (*d*) the communications of the pudic, hæmorrhoidal, and vesical trunks *with* those of the opposite side.

Ligature of the Internal Iliac Artery is occasionally performed for hæmorrhage from, or aneurism of, one of its branches, the gluteal being that most commonly affected. The trunk is a short one, at most 1½ inches in length, and is best reached by opening the abdomen in the middle line below the umbilicus (Fig. 93, C), pushing aside the intestines, and searching for the bifurcation of the common iliac. The posterior layer of the peritoneum is then carefully incised, the ureter avoided, and an armed aneurism needle passed without wounding the vein.

The *Collateral Circulation* is the same as that given for the internal iliac division of the common iliac.

The **Gluteal Artery** occasionally needs to be secured at its point of emergence from the pelvis through the upper part of the great sacro-sciatic foramen. This spot is indicated by the junction of the inner and middle thirds of a line drawn from the posterior superior iliac spine to the top of the great trochanter.

An incision is made in the direction of this line—*i.e.*, along the fibres of the gluteus maximus, which are separated and held apart. The deep fascia beneath this muscle is then opened up, and the space between the gluteus medius and pyriformis defined. Through this the upper margin of the sacro-sciatic notch can be detected, as also the pulsation of the artery. The vessel must be secured as deeply as possible on account of its early division. It is always a troublesome dissection, and possibly in most cases it would be wiser to deal with the trunk of the internal iliac from the front.

The **Sciatic and Pudic Arteries** seldom require to be tied, but may be reached opposite the ischial spine, at the junction of the middle and lower thirds of a line drawn from the posterior superior iliac spine to the tuber ischii. An incision

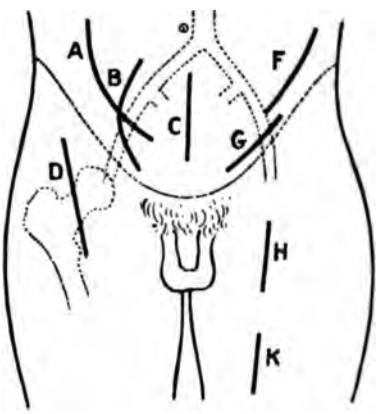


FIG. 93.—INCISIONS FOR OPERATIONS ON LOWER PART OF ABDOMEN AND UPPER PART OF THIGHS.

A, Mott's incision for tying common iliac artery; B, Marcellin Duval's incision for the same; C, incision for transperitoneal ligature of internal iliac artery; D, incision for excision of hip by the anterior method; F, Abernethy's modified operation for ligature of external iliac; G, Astley Cooper's incision for same; H, ligature of femoral artery at apex of Scarpa's triangle; K, ligature of femoral artery in Hunter's canal.

about 4 inches in length is made over this spot, corresponding in direction to the fibres of the gluteus maximus, which are separated. The spine of the ischium and lower border of the pyriformis should now be defined, and the vessels and nerves seen emerging from the foramen. The pudic vessel lies to the inner side of the sciatic; the ligature is passed as high as possible.

The **External Iliac Artery** is easily accessible in any part of its course, which measures from 3½ to 4 inches in length; it has but few branches, and those situated low down. Its position is indicated by the lower two-thirds of a line drawn from the bifurcation of the aorta to midway between the anterior superior spine and the symphysis pubis—*i.e.*, to a point a little internal to the middle of Poupart's ligament.

Many suggestions as to the best means of reaching the artery have been made, and both trans- and extra-peritoneal methods have been adopted. It is so readily secured, however, by the latter that it seems unnecessary to open the peritoneum. There are two chief forms of extraperitoneal operation.

Astley Cooper's Operation.—An incision is made parallel to the outer half of

Poupart's ligament, commencing a little to the inner side of its centre, and ½ inch above it, and extending upwards and outwards to about 1 inch internal to the anterior superior spine (Fig. 93, G). The external oblique aponeurosis is divided along this line, and the exposed lower margins of the internal oblique and transversalis muscles arching over the inguinal canal are drawn upwards by retractors. The transversalis fascia and loose subperitoneal fat are now opened with forceps and director, and the vessel is felt pulsating immediately under the finger. It is very important not to damage either the epigastric or circumflex iliac arteries during this manipulation, since they are most essential factors in establishing the collateral circulation, whilst the circumflex iliac vein crossing the main trunk must also be avoided. The needle is passed from within outwards, the ligature tied, and the divided muscular and aponeurotic structures united by buried sutures.

Abernethy's Modified Operation is more commonly utilized. The incision, about 3 inches in length, extends from a point 1½ inches within and above the anterior superior iliac spine to just external to, and ½ inch above, the middle of Poupart's ligament (Fig. 93, F). Through this the aponeurosis of the external oblique is divided along the course of its fibres, as also the internal oblique and transversalis. The transversalis fascia is now carefully incised; it varies considerably in thickness, being sometimes well developed, but is occasionally so attenuated as to be scarcely recognisable, and in such cases the peritoneum may unintentionally be opened. In the present day this is an accident of slight importance, the wound being readily closed by a continuous suture, and no harm resulting. The fingers are now introduced into the wound, and the peritoneum and its contents stripped from the iliac fossa, and drawn inwards and forwards, where they are kept out of the way by a broad spatula. In the space thus opened up we can see the iliacus muscle covered by its fascia, and to its inner side the rounded outline of the psoas. The vessel lies to the inner border of this, and can usually be readily found, enveloped in a fascial sheath, with the genito-crural nerve coursing over it, and perhaps some lymphatic glands upon it. The artery is separated from the vein which lies to the inner side, and the needle passed from within outwards. If the transversalis fascia has not been properly opened, it is quite possible to strip it up together with the peritoneum, and carry the vessels forwards with it, when they may be found under cover of the spatula.

On comparing the two operations, we are very distinctly in favour of the latter plan. By Cooper's method the artery is tied very close to important collateral branches, whilst but a small portion of the trunk is exposed, so that if this is diseased and unsuitable for the application of a ligature, no further choice is possible. In Abernethy's, on the other hand, the vessel is tied well away from collateral branches, and if the exposed portion of the trunk is diseased, the common iliac can be reached and secured without much difficulty by extending the incision upwards. As to the greater tendency to hernia stated to exist in this method, this may have been the case in pre-antiseptic days, when the muscles were not sutured for fear of retaining septic discharges; but careful asepsis, the use of buried sutures, and the possibility of doing without drainage tubes, should render such a sequela impossible.

Collateral Circulation.—Anterior set: Superior epigastric of internal mammary, lumbar, and lower intercostals *with* superficial and deep epigastric in sheath of rectus.

Posterior set: Gluteal and sciatic *with* internal and external circumflex and first perforating or profunda at back of great trochanter (crucial anastomosis).

External set: Ilio-lumbar and gluteal *with* deep and superficial circumflex iliac and ascending branch of external circumflex.

Internal set. Obturator *with* internal circumflex; and terminal divisions of internal pudic *with* superficial and deep external pudic.

The **Common Femoral Artery** is but rarely ligatured, except as a preliminary measure in amputation at the hip-joint, since the number of branches arising from it is likely to interfere with its sound occlusion, and the collateral circulation is better after ligature of the external iliac. It may be reached by a vertical incision over the line of the vessel, extending both a little above and below Poupart's ligament. The superficial lymphatics and veins must be carefully avoided,

the fascia lata divided, the sheath exposed and opened, and the ligature passe from the inner side.

Collateral Circulation.—Internal set: Obturator *with* internal circumflex, a internal pudic *with* external pudic.

External set: Circumflex iliac *with* ascending branch of external circumflex,

Posterior set: Gluteal and sciatic *with* internal and external circumflex, and fi perforating; comes nervi ischiadici *with* perforating of the profunda and muscul of popliteal.

The **Superficial Femoral Artery** is indicated by a line drawn from midw between the anterior superior spine and the symphysis pubis to the tuberosit of the internal condyle, the limb being flexed, adducted, and a little everted. may be secured at 'the site of election'—*i.e.*, at the apex of Scarpa's triangle—o in Hunter's canal.

Ligature at the Apex of Scarpa's Triangle.—A 4-inch incision is made in th line of the artery, the centre being about 4 inches (or a hand's breadth) belo Poupart's ligament (Fig. 93, H). The integument and fasciæ are divided, th inner border of the sartorius exposed, and the sheath found immediately behin it, the muscle being drawn slightly outwards; the middle cutaneous nerve i perhaps brought into view. A muscular branch to the sartorius may be me with at this spot, and should be separately ligatured. The vein is placed behin the artery, so that the needle may be passed either way, special care being take to keep it close to the vessel.

Collateral Circulation.—External circumflex *with* lower muscular of femora anastomotica magna, and superior articular of popliteal.

Profunda femoris by its perforating and terminal branches *with* the muscul and articular branches of femoral and popliteal.

Ligature in Hunter's Canal.—An incision 4 inches in length is made along th line of the artery in the middle of the thigh (Fig. 93, K). The sartorius is expos by division of the fascia lata, its fibres running downwards and inwards; th outer border should be defined, and the muscle retracted inwards. The ap neurotic covering of Hunter's canal is now in view, stretching between th adductor longus and vastus internus; it is incised, and the sheath of the ves found below it, with the nerve to the vastus internus lying to its outer side, th long saphenous nerve crossing it from without inwards, and the vein passi behind it, to become external lower down. The needle may be passed in eith direction, and the ligature should not be placed too low on account of th contiguity of the anastomotica magna. A common mistake made by students tying this artery on the dead subject is to burrow down along the vastus intern on the outer side of the vessels; this is to be avoided by always keeping close the under surface of the sartorius until the glistening transverse fibres Hunter's aponeurosis are clearly visible.

Collateral Circulation is maintained through the profunda and its branches.

The **Popliteal Artery** may be tied either just after it has passed through th adductor opening, or in the depths of the popliteal space, but preferably in th former situation. Neither operation is often required.

To tie the *upper part*, the limb is fully abducted and everted so as to enab the adductor tubercle and tendon of the adductor magnus to be clearly define An incision, 4 inches in length, is then made from the tubercle upwar (Fig. 94, A), and the tendon exposed. The internal saphenous vein and ner may be seen, but are drawn backwards by means of a broad retractor, togeth with the sartorius, gracilis, and semi-membranosus. If possible, the branch the anastomotica magna which courses along the tendon should be spared. Th fascial space behind is now opened up, and the artery found surrounded by good deal of loose connective tissue. The vein is usually seen on the outer sid and is here very thick and dense, so that in the dead subject it can be read mistaken for the artery.

The *lower part* is tied through an incision in the middle line of the poplit space, dividing the deep fascia and drawing out of the way the heads of th gastrocnemius muscle and the internal popliteal nerve. The vein is superfic to the artery, and is found by following the short saphenous trunk. The need is passed from the inner side.

Collateral Circulation is maintained by the anastomoses around the knee-joint.
The **Posterior Tibial Artery** but seldom requires to be ligatured except for
morrhage, or on the face of amputation stumps; hence the operations
scribed below are rarely seen away from the dead-house. The line of the
sel is indicated by one drawn from the centre of the popliteal space to a
int a finger's breadth behind the internal malleolus.

1. *In the Middle of the Calf.*—The leg is placed on its outer side and flexed,
d an incision 4 inches long is made a finger's breadth behind the inner border

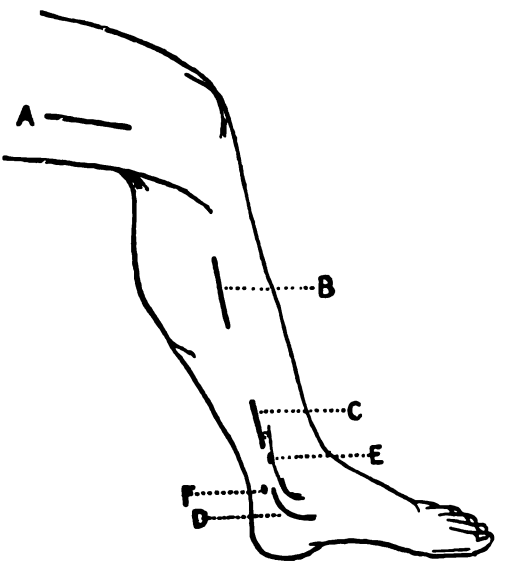


FIG. 94.—INCISIONS FOR LIGATURE OF THE UPPER PART OF THE POPLITEAL (A), AND OF THE POSTERIOR TIBIAL ARTERIES (B, C, AND D).

E, Site for Introduction of Knife in Tenotomy of Tibialis Posticus;
F, Ditto for Tendo Achillis.

f the tibia (Fig. 94, B), dividing the skin and subcutaneous tissues, the long
phenous vein and nerve being drawn aside if necessary. The tibial origin of
e soleus is thus exposed, and incised directly towards the tibia, until the fibrous
oneurosis on its deeper surface is met with. This having been cut through,
e muscle is drawn backwards with the retractor, and the vessels, ensheathed
a deep layer of fascia, are seen lying on the tibialis posticus, and with the
terior tibial nerve to the outer side. The venæ comites are separated, if
sible, and the ligature passed from the nerve. Sometimes the above-men-
ed aponeurosis is in the substance of the soleus, and a thin layer of muscular
es exists on its deeper aspect.

2. *In the Lower Third of the Leg.*—An incision is made midway between the
lo Achillis and inner border of the tibia (Fig. 94, C). The skin and fasciæ,
ding the upper part of the internal annular ligament, are divided, and the
els seen lying on the flexor longus digitorum, with the nerve behind and to
ter side.

Behind the Malleolus.—An incision is made about a finger's breadth from
alleolus, curving round its lower border (Fig. 94, D). The deep fascia (or,

as it is here termed, the internal annular ligament) is divided over the vessels between the tendons of the flexor longus digitorum and flexor proprius hallucis, and the artery is then readily cleared and ligatured. The sheaths of the tendons should not be opened.

The **Anterior Tibial Artery** is found along a line stretching from a point midway between the outer tuberosity of the tibia and the head of the fibula above to the central point between the two malleoli below. It may be tied in three situations.

1. *In the Upper Third of the Leg.*—An incision is made exactly in the line of the artery (Fig. 95, A), and the deep fascia incised. The intermuscular space between the tibialis anticus and the extensor communis digitorum is opened.

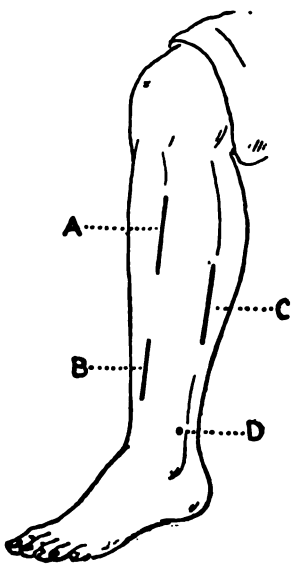


FIG. 95.—INCISIONS FOR LIGATURE OF ANTERIOR TIBIAL (A AND B) AND PERONEAL (C) ARTERIES. D, SITE FOR INTRODUCTION OF KNIFE IN TENOTOMY OF PERONEI.

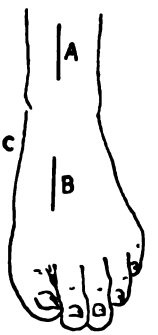


FIG. 96.—INCISIONS FOR LIGATURE OF LOWER PART OF ANTERIOR TIBIAL (A) AND DORSALIS PEDIS (B) ARTERIES. C, SITE FOR PERFORMING TENOTOMY OF TIBIALIS ANTICUS.

The vessel lies between these muscles upon the interosseous membrane, the anterior tibial nerve being to the outer side.

2. *In the Middle of the Leg* (Fig. 95, B).—The same intermuscular space is opened, being indicated here by a definite white line, due to a slight subfascial deposit of fat. The vessels lie between the tibialis anticus and the deeply-placed extensor proprius hallucis, the nerve usually lying on the artery and needing to be drawn aside.

3. *In the Lower Third of the Leg.*—An incision is made in the line of the artery, reaching upwards for 2 inches from a point just above the ankle (Fig. 96, A). The deep fascia and upper part of the annular ligament are divided, and the vessel is found between the tendons of the tibialis anticus and of the extensor proprius hallucis, the nerve lying to the outer side.

The **Dorsalis Pedis Artery** extends from the centre of the line between the two malleoli to the interval between the bases of the first two metatarsal bones. An incision is made in this direction (Fig. 96, B), the deep fascia opened, and the artery found lying between the extensor proprius hallucis, which has now crossed and is internal to the vessel, and the innermost slip of the extensor brevis digitorum. It is not always easy to find, and for practical purposes the best plan would be to divide the vessel by an incision extending to the bones, and then pick up and tie the bleeding ends.

The **Peroneal Artery** can be reached through an incision along the posterior border of the centre of the fibula, the leg being laid on its inner side (Fig. 95, C). The outer edge of the soleus is defined and drawn inwards, the lower fibres of attachment to the fibula being divided if necessary. The flexor longus hallucis is thereby exposed, and incised in such a manner as to allow the surgeon to reach the postero-internal border of the fibula; the artery is then readily found lying in an osseo-aponeurotic canal.

CHAPTER XIII.

SURGERY OF THE VEINS.

Thrombosis.

By **Thrombosis** is meant intravascular coagulation in any part of the circulatory system. Normally the blood remains in a fluid condition, owing to some inter-action between it and the vessel walls. Any factor producing a disturbance of this normal equilibrium may determine thrombosis, and any part of the vascular tract may be affected by it, whether the heart, arteries, veins, or capillaries. We have already discussed some of the conditions associated with capillary or arterial thrombosis; that which follows, whilst referring primarily to venous thrombosis, is also in a measure true of the other forms.

Causes.—(1) *Changes in the vessel walls*, as a result of which the integrity of the endothelium is disturbed—*e.g.*, injury (either division, rupture, puncture, compression, or contusion), inflammation or degeneration (as in varicose veins).

(2) *Changes in the constitution of the blood*, whereby its coagulability is increased. Excess of excretives, as after pregnancy during involution of the uterine walls, may have this effect, or the presence of toxins arising from bacterial activity; hence septic diseases are commonly associated with thrombosis. Great loss of blood up to a half of the whole amount in the body also increases its coagulability, but excess of leucocytes, as in leukæmia, has the opposite effect. A. E. Wright has shown that the percentage of calcium chloride in the blood is an important factor. If 0·6 per cent. of this salt is present, coagulation is hastened, and he has proposed to reduce the loss of blood during operations to a minimum by injecting into the rectum half an hour previously a pint of warm water containing 2 ounces of this salt in solution. In one or two cases in which we have seen it used, it appeared to be efficacious, but its general utility is doubtful, since it might lead to coagulation in unwished-for localities.

(3) *Diminished rate of the blood-stream* predisposes to thrombosis if some other condition is present to determine it. Lister showed years ago that blood can remain fluid for a long time if confined in a tube formed of a suitable length of the vein wall; but when either of the preceding factors is present, a retardation of the blood-stream

...ack spaces being left behind them in which the blood
. Coagulation is probably determined by some slight injury
re which is not noticed by the patient, or by some lessened
f the wall of the vein, or by disintegration of the leucocytes
ng free of fibrin ferment owing to the defective circulation.
s thus formed behind the valves gradually increase in size
whole lumen of the vessel is obstructed.

hite leg of the puerperal woman, or, as it is sometimes *hlegmasia alba dolens*, is sometimes induced in the same way, it is probable that in most cases the coagulum extends to ral vein from the uterine plexuses. A similar condition ring or after appendicitis, and may then be due to the ion of inflammatory phenomena around the iliac vein, if it ne right leg, but curiously enough the left leg is much more y affected in this as in every other condition. It may occur form of operation, and is generally associated with sepsis of e or other, though perhaps of a very mild description. The ay gradually spread upwards, even to the vena cava.

aracter of the clot varies according to whether it is deposited is due to a rapid coagulation of the blood. In the former o-called *White Thrombus* is met with, which is formed upon, res to, the vessel wall, and gradually increases by fresh of fibrin until it entirely blocks the channel. If a certain f red corpuscles are entangled in the meshes of the clot, it l a *Mixed Thrombus;* the more rapid its formation, the ne number of red corpuscles present. Should the blood *en masse* in a vein, as after its total division or ligature, an *Red Thrombus* is produced, which at first is not adherent to but becomes so later on, especially at its base. A similar ot is usually found *post-mortem* capping any white clot which ed previously.

fects of thrombosis may be considered under the following : local, distal, and proximal.

sepsis, no harm need follow; but if septic in origin, local al or even diffuse suppuration, may occur along the vein, toget general pyæmia. (*d*) The clot may shrink or become loosen ampulla of a varicose vein, forming a fibrinous mass which quently infiltrated with calcareous particles, constituting a v or *Phlebolith*.

Distally, congestion of the terminal veins is caused by the tion to the circulation, and if a main trunk is affected, of the limb follows, and possibly ulceration or gangrene. It remembered, however, that if the condition affects the femora a person in the recumbent position, there may be very litt œdema as long as the limb is kept up. The diagnosis must made by the pain along the cours vein, which can be felt as a hard c favourable cases the collateral ci is soon established by the opening dilatation of other venous channe after a time may become varicos situated superficially, are often very Thus, if the common femoral or iliac vein is occluded above Poupa ment, the internal saphenous an ficial epigastric veins become diste varicose, and the latter may be seen up the abdominal wall towards th cus, and uniting with the same b the opposite side to find its wa saphena vein of that limb. If th vena cava is obstructed, the mamm epigastric veins become dilated and standing out prominently on the abdominal wall.

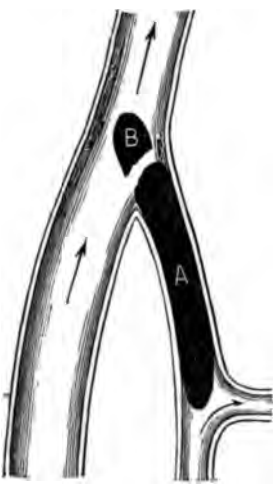


FIG. 97. — THROMBUS AND EMBOLUS. (KEEN AND WHITE.)

A, Thrombus *in situ*; B, embolus detached from the same.

Proximally, the process may extend upwards, and finally involv and more important trunks than which it originated. Moreover, of a thrombus may be detache *Embolus* (Fig. 97, B). If the clot going molecular disintegration and only minute portions are they are filtered off by the lungs or kidneys, and no sympto be caused. If, however, a large portion is detached, urgent and even death occur from obstruction to the pulmonary ve subsequent arrest of the circulation. If the clot becomes s fragments conveying organisms are carried into the ci pyæmia is the result, preceded, however, in the portal area phlebitis—*i.e.*, suppurative phlebitis of the portal trunks in t

The **Clinical Signs and Treatment** of venous thrombosi same as for phlebitis (*q.v.*).

Embolism.

An **Embolus** is the term applied to any foreign body which travels for a greater or less distance in the bloodvessels until it becomes lodged within them and causes obstruction. There are four main varieties of embolus: (*a*) **Simple Emboli**—*e.g.*, blood-clot, granulations or fibrinous vegetations from the cardiac valves after acute endocarditis, atheromatous plates, air-bubbles, fat globules, etc. (*b*) **Infective Emboli** consist of either zoogloea masses of bacteria or disintegrated portions of blood-clot carrying micro-organisms and originating a pyæmic abscess wherever they lodge. (*c*) **Malignant Emboli** are formed by portions of some malignant growth, from which the various secondary deposits originate; such are met with more frequently in the sarcomata than in the carcinomata. (*d*) **Parasitic Emboli** also occur, such as the ova and scolices of the *Tænia echinococcus* and the *Filaria sanguinis hominis*.

Emboli may be detached from the heart, veins, or arteries, although necessarily they are never arrested in a systemic vein, but only in the arteries or portal vein. They are of all sizes, and the character of the resulting symptoms depends much on this. A large embolus started in a peripheral vein lodges in one of the branches of the pulmonary artery, and may cause instant death; a smaller one is arrested in one of the smaller arteries of the lung and may do but little harm, whilst minute ones may possibly pass through the pulmonary capillaries to the left side of the heart, and subsequently become impacted in the systemic vessels.

Effects of an Embolus.—The **Local** effects of the lodgment of a simple embolus consist, firstly, in the deposit of fibrin upon it, rendering the obstruction complete; organization of the thrombus usually follows, although occasionally it may disintegrate and disappear. Under these circumstances a weak spot may be left in the arterial wall, from which an aneurism is subsequently developed. The local effects of infective, malignant, and parasitic emboli are dealt with elsewhere.

The **Distal** effects of embolic obstruction depend entirely on the relation of the vessel blocked to the surrounding circulation.

1. Should the embolus be lodged in an artery which gives off anastomotic branches below the point of obstruction, or if the capillary anastomosis is abundant, a **transient anæmia** is all that occurs in most cases. If the artery is small, or goes to unimportant structures, no symptoms need arise from this; but if the vessel is large, or supplies delicate and important tissues, serious results may follow even a temporary arrest of the circulation; thus, embolus of the central artery of the retina always causes permanent blindness, although the retina still lives.

2. Should the embolus block what Cohnheim called a 'terminal artery' (*i.e.*, one with no anastomosis between the embolus and the terminal capillaries), or a vessel with insufficient collateral circulation, the obstruction will lead to **death** of, at any rate, a portion of the anæmic region—*e.g.*, gangrene in a limb, or white or yellow softening in the brain. In an organ such as the kidney or spleen, the result of embolic obstruction to one of the terminal arteries is the development of what is known as an **infarct**—*i.e.*, a wedge-shaped area of tissue with the blocked artery at its apex becomes devitalized, and in consequence looks white and feels firmer than the surrounding parts. The tissues cannot be properly stained for microscopic purposes. Sometimes the anæmic area becomes engorged with blood to such an extent as to lead to extravasation, and a firm, solid patch of a dark-red colour results, known as a **hæmorrhagic infarct.** Whatever its appearance, the infarct is subsequently invaded by granulation tissue developed from the surrounding healthy parts, and this finally results in the formation of a depressed cicatrix containing, perhaps, a few hæmatoidin crystals. The conditions necessary for the production of an infarct are met with in the lungs, spleen, kidney, and brain; in the liver the anastomosis is generally too free to allow of its formation, although it has been known to occur.

Effects of the Lodgment of Emboli in Various Organs.—In the **Brain**, the middle cerebral artery is most commonly blocked, resulting in immediate hemiplegia, which may be almost entirely recovered from, but commonly leaves some impairment of function. In children the symptoms are less marked, but aneurism of the affected vessel occasionally follows. In the **Central Artery of the Retina**,

sudden, total, and irremediable blindness is produced; the branches of the vess are seen to be almost empty, the retina becomes œdematous, the macula alo retaining its normal colour, appearing as a cherry-red spot, contrasting marked with the pallid œdematous tissues around. In the **Lung**, fatal results superven from obstruction to a large vessel; whilst, if a smaller one is blocked, a certai amount of pain and dyspnœa is produced, followed by the formation of an infarc as indicated by dulness, bronchial breathing, and bronchophony. In the **Live** an embolus of the hepatic artery causes sudden hypochrondriac pain, and perha a passing glycosuria. The portal vein and its branches are not unfrequent obstructed by emboli, which, being usually of a septic nature, give rise to pyæmi symptoms (pylephlebitis). In the **Spleen**, a sudden pain in the left hyp chrondrium is experienced, the organ becomes enlarged, and a considerable ri of temperature may follow. In the **Kidney**, sudden pain in the loin and a tem porary hæmaturia constitute the main symptoms. In the **Intestine**, localiz ulceration or extensive gangrene is likely to follow, according to the size of th vessel obstructed. In the **Limbs**, the emboli usually lodge at the bifurcatio of main vessels, often saddling across the fork, and blocking both branche Sudden pain is felt at the spot, shooting downwards, and either recovery t gangrene ensues (p. 100).

Phlebitis.

Phlebitis, or inflammation of the vein wall, arises from a varie of causes, and is not uncommon in surgical practice. The followin forms may be described:

1. **Simple Phlebitis**, in which a more or less *localized* inflammatio of the wall of a vein is attended by thrombosis: it extends for variable distance up and down the vessel, but usually not furth than the next patent branches. (*a*) It may arise from *injury*, eith subcutaneous or open, or from the continued pressure and irritatio of a tumour or aneurism; (*b*) it may be *idiopathic* in nature, attackin the larger veins of the lower extremity, or vessels which have be long subject to varix, especially in gouty individuals. (*c*) It ma follow primary thrombosis, either in a main trunk or in a varico peripheral vein; or (*d*) it may be induced by inflammation of th tissues around the vein (*periphlebitis*), usually of septic origin.

2. **Infective Phlebitis** is a much more serious condition, inasmu as the thrombus resulting therefrom is always invaded by mic organisms, and the disease is often of a *spreading* type. It was th form of phlebitis which in the old days so commonly followed ope tions, and made surgeons fear any interference with veins; it h now been almost banished as a sequela of surgical operations antisepsis, and there is no more fear of dealing with veins than wi any other tissue of the body. It may, however, arise (*a*) in traumat cases where asepsis has not been attended to or has failed, th organisms invading the clot which lies in the open mouth of the ve or (*b*) as a result of septic periphlebitis in wounds, or in septic inflam mation of bones, such as when a septic mastoiditis leads to disea of the mastoid emissary vein and of the lateral sinus. The usu results are localized or spreading suppuration in the course of a around the vein, and general pyæmia. (*c*) It may possibly be induc by auto-infection of the clot present in simple phlebitis.

The **Morbid Anatomy** of phlebitis shows nothing unusual; t walls of the vein are congested and thickened, and the endothe

lining is hypertrophied; the thrombus contained in the vessel varies in its characters. If infected, it becomes soft and pultaceous, resembling dirty-looking pus; a localized abscess may form, or the suppuration may extend for some distance along and around the vein. In the more favourable cases the spread of the infection is limited by the terminal portions of the clot remaining firm and unaffected.

The **Symptoms** of inflammation of a **superficial** vein are sufficiently obvious. The vessel becomes swollen, hard and painful, with localized enlargements or knobs corresponding to the valves or to the pouches in varicose veins. The skin over them is dusky and congested, and there may be some œdema of the region from which the blood flowing in the vein is gathered; this, however, rarely amounts to much, since the collateral circulation is always abundant. If suppuration occurs, the signs of a localized abscess are noted; on opening this, care must be devoted to maintaining the part aseptic, in order to prevent, as far as possible, the extension of the inflammation.

When the **deeper** veins are involved, it may be impossible to detect them on palpation, although a blocked common femoral is easily felt; but acute deeply-seated pain over the vein and well-marked fever are characteristic evidences of what has occurred. Œdema of a more or less solid character develops, although if the limb is maintained in the horizontal position throughout the attack this need not occur. Obliteration of the vessel, and any of the local, distal, or general processes detailed under thrombosis (p. 343), may result.

The onset of **Septic Spreading Phlebitis** is marked by fever and perhaps rigors, whilst the local signs are due to the rapid extension of a suppurative inflammation along the vein and its branches, so that a large tract of tissue is very quickly invaded, and diffuse suppuration follows. The development of pyæmia would be indicated by a repetition of the rigors.

Treatment of Simple Phlebitis.—The limb must be kept absolutely at rest to limit the inflammation and to prevent the detachment of emboli, and also elevated to assist venous return. Locally, belladonna fomentations may be applied, or the parts may be painted with glycerine and extract of belladonna, swathed in a thick layer of cotton-wool, and lightly bandaged. The patient should be kept on an unstimulating though nutritious diet, and the general health attended to. When every sign of inflammation has subsided, and sufficient time has been allowed for the absorption or organization of the clot (six to eight weeks), massage may be commenced, to assist in the removal of œdema and local thickening, and an elastic bandage is usually serviceable in restoring the circulation. Operation is sometimes undertaken in cases of phlebitis associated with varix, but not when the deeper veins are involved. If abscesses form, they must be opened antiseptically.

Spreading Infective Phlebitis is treated by following up the suppurative process with the knife, laying open the tissues around the involved veins. The wounds thus made should be treated with peroxide of hydrogen and lightly stuffed; at the same time, the limb

is raised and kept absolutely quiet. Should pyæmic phenomena develop, it may be possible to place a ligature between the disintegrating clot and the heart, and to scrape or wash away the septic mass; thus in septic thrombosis of the lateral sinus, following suppuration in the middle ear, the internal jugular vein should be ligatured, the lateral sinus opened, and the clot removed. Of course, such treatment is only feasible in cases where a single trunk is affected. When the process affects the veins of a limb, and cannot be stopped by either of these plans of treatment, the question of amputation may even have to be raised.

Varicose Veins, or Varix.

A vein is said to be varicose, or in a condition of varix, when it has become permanently lengthened, dilated, and more or less tortuous. The superficial veins of the leg, especially the internal and external saphena, are those most commonly affected; the spermatic veins are often in a similar condition, constituting what is known as a varicocele, whilst piles are primarily due to varicosity of the hæmorrhoidal plexus. We shall here only deal with the first of these three manifestations.

Causes.—Varix is probably due, in the first place, to some congenital weakness of the venous wall, or irregularity in the arrangement of the valves, though possibly this produces no effect until some exciting cause comes into action and throws a strain on the circulation. The facts that varicose veins are hereditary, even the same vein being often involved in different members of a family, and that varix sometimes appears quite early in life, and without adequate cause, confirm this hypothesis.

As exciting causes may be mentioned any condition which leads to a frequently repeated or more or less permanent distension of a vein, such as prolonged standing, as in those serving behind counters; the pressure of tight garters, especially if worn below the knee; prolonged or forcible exertion of the limb, as possibly in cyclists, whereby the blood is driven from the deeper into the more superficial veins; the pressure of a pregnant or displaced uterus, or of a pelvic tumour. Obstruction to and occlusion of the deeper veins is another well-recognised cause of varix, and we have already drawn attention to the effects produced by blocking of the common femoral vein and inferior vena cava. A less known instance is the varix of the internal saphena or some of its branches below the knee which follows thrombosis of the venæ comites of the posterior tibial, due to strains of the leg and similar injuries. If the thrombus is absorbed, the dilatation disappears; but if the block is permanent, the superficial veins become varicose, usually extending to just below the knee. Any abnormal communication between an artery and a vein also causes varicosity, from the inability of the latter to withstand arterial blood-pressure (*vide* Aneurismal Varix, p. 296). The tendency to varix increases with age till the middle period of life is reached, and is

favoured by the relaxation of the system resulting from sedentary habits. When once a vein has become varicose and its walls are thin and expanded, the valves become incompetent, and the superincumbent weight of the blood tends to still further increase the mischief.

Morbid Anatomy.—To the naked eye a varicose vein in an early stage appears thickened, distended, and tortuous; the walls are so thick that the vein when cut across does not collapse, but presents a gaping mouth, like an artery; the valves atrophy, and are functionally useless. After a time the walls become further stretched and irregularly expanded, forming here and there large pouch-like dilatations, which are very obvious under the attenuated skin, to which they are often adherent. Microscopically, the change consists in a transformation of the normal structures of the vein wall into fibro-cicatricial tissue. The tunica media is mainly affected, most of the muscular fibres disappearing, whilst the tunica intima is but little changed, and the adventitia thickened. In the pouches the middle coat is atrophied, and, indeed, is often completely absent.

FIG. 98.—VARIX OF INTERNAL SAPHENA. (FROM A PHOTOGRAPH.)

Clinical History.—The enlarged veins are seen ramifying under the skin with a more or less tortuous and serpentine course (Fig. 98), and they often feel thickened. One or more veins may be affected, and the tortuosity may be at parts so marked as to constitute large clusters of dilated vessels, which look bluish under the attenuated skin. Should the upper end of the internal saphena be involved, it is almost always dilated so as to form a large pouch, which opens by a wide mouth into the femoral vein.

The **Effects** of this condition are very varied. The circulation in the lower parts of the leg may be impaired, especially that of the skin. The limb feels heavy and painful; forcible exertion may cause a sensation of tension, and after standing or exercise there is usually a little œdema of the ankle. The capillaries in the papillæ often become dilated, appearing as minute reddish puncta, which subsequently run together and form brownish patches of pigmentation. Eczema is induced by the irritation of rough and coarse trousers or dirt, often terminating in actual ulceration. Any lesion, such as a scratch or abrasion, instead of healing readily under a scab, tends to spread and form an ulcer. Injury to the vein may lead to thrombosis and spontaneous cure, but coagulation sometimes occurs idiopathically in the pouches, especially in gouty subjects. The clot may subsequently shrink and form a small fibrinous or calcareous mass, known as a 'phlebolith,' but sometimes the thrombosis spreads into deeper or larger veins, and then

fragments of clot may be detached as emboli. Occasionally the dilated pouch of a varicose vein gives way, and an alarming gush of blood results; the same may follow the extension of ulceration through the vein wall. The blood under these circumstances is derived, not only from the lower, but also from the upper end, inasmuch as the valves have become incompetent; a column of blood extending from the right auricle is thus tapped near its lower end, and, unless prompt precautions are taken, the patient's life may be lost.

The **Treatment** of varicose veins may be described as palliative and radical.

Palliative Treatment consists in removing any source of obstruction in the shape of tight garters, in limiting the amount of standing, in moderate massage, together with the application of either an elastic stocking or an indiarubber bandage. The bowels should be kept well open, and the general health attended to. Eczema may be treated by the application of soothing and drying ointments, *e.g.*, ung. zinci benzoatis; or if the skin is chronically infiltrated and thickened, by the use of weak tarry applications, *e.g.*, ol. Rusci (1 part to 4 of vaseline), or of ichthyol (5 or 10 per cent. in vaseline). Varicose ulcers are treated on ordinary principles, or by Unna's method (p. 89); but repair is often delayed till the veins have been dealt with by operation.

Radical Treatment consists in the excision of the distended veins. Before operating it is important to make certain that the condition is not due to thrombosis of the deep trunks, as interference would then do more harm than good, and the varix would be certain to recur in neighbouring collateral veins. Operation is specially indicated when thin, dilated pouches exist; when elastic stockings cannot be comfortably worn, as in the tropics; when ulcers exist which refuse to heal; when the condition is very extensive and painful, and especially if large bunches of dilated veins are seen; or when there is a distinct impulse or thrill on coughing, indicating that the valves which protect the veins of the leg are defective. It may not be practicable to remove all, but if the largest and most prominent are taken away, the others will probably shrink and disappear. There are two chief plans of doing this: (*a*) Small portions are removed at several different situations. The skin is pinched up over the vein, and incised by transfixion; the vessel is usually bared by this means, but may need a little cleaning. An aneurism needle is passed beneath it, and the vein isolated sufficiently to allow of its being grasped by two pairs of forceps, and divided between. Each end is now freed, and drawn out of the wound as far as possible; it is then ligatured and removed. Probably 2½ inches of vein may be taken away through a 1-inch incision. The wound is sutured without drainage and dressed. (*b*) Long incisions are made, perhaps 6 inches or more, through which larger clusters of veins may be dealt with. The wound should not lie over the most dilated parts of the vessel, as there the skin is often thin and unhealthy, but should be curved so as to include as much sound skin as possible, whilst crossing the vessels once or

twice. All collateral branches, especially the deep ones, must be secured, and this, in fact, constitutes the great advantage of the operation, viz., that so many anastomosing channels are obliterated. (*c*) A simpler procedure has been advocated by Trendelenburg, viz., the removal of a portion of the internal saphena high up, so as to break the weight of the superjacent column of blood. In many cases, but especially where there is an impulse on coughing, it is a most valuable measure, though the enlarged veins lower down should also be excised. (*d*) When varix involves the upper end of the internal saphena, which is dilated to constitute an ampulla, it is scarcely advisable to attempt removal of the pouch, as the communication between it and the main trunk is so short and wide that the application of a ligature becomes risky, and a sudden rise of intravenous pressure, as by vomiting, might force off the ligature. The vein must be tied below the pouch, which will become contracted, with or without clotting of its contents, when the blood-current is deflected.

After an operation for varix the patient should remain in the recumbent posture for three weeks, to allow clots to become firm and to permit the circulation to accommodate itself to the new arrangements. On first rising from bed, it is well to support the limb for a time by an elastic stocking, indiarubber bandage, or, better still, by a 'Crêpe Velpeau' bandage.

Inflamed Varicose Veins are not unfrequent, and may result in a natural cure of the condition. The symptoms are those of a superficial phlebitis, and the treatment indicated for that condition should be followed. In cases where there is much pain it may be justifiable to excise the thrombosed vessels, taking the precaution first to secure by ligature the vein above the clot, so as to prevent any risk of embolic detachment. Operation of a similar type is also required when thrombosis is gradually spreading upwards, and threatening to affect the deep trunks, *e.g.*, in the neighbourhood of the saphenous opening; or when portions of clot are being detached as emboli, giving rise to pulmonary symptoms.

Hæmorrhage from a Ruptured Vein needs prompt and decisive treatment. The bleeding spot should be commanded by digital compression, and the patient laid on the back with the limb elevated, until either a pad of antiseptic dressing can be applied to the wound, or a handkerchief or bandage secured over it.

Nævus.

A nævus is a vascular tumour developing in the skin or mucous membrane and in the underlying tissues, and consists of a congeries of vessels held together by connective tissue. Nævi are of congenital origin, or develop soon after birth. Left to themselves, they may shrink and disappear, but more often they increase in size more or less rapidly, whilst sometimes they remain passive and persist through life. Two chief varieties are described:

The **Capillary Nævus** (or mother's mark) occurs in the form of a

slightly raised flattened mass, bright red or purple in colour, according to the relative amount of arterial or venous blood present, and with occasionally a somewhat irregular or nodulated surface, in which larger vessels may be seen ramifying. It consists merely of a mass of capillaries lined with endothelium communicating with a few arterioles and venules, and held together by loose connective tissue. Several such growths may be present in the same individual, and they are usually quite small, not exceeding an inch or two in diameter, though sometimes they extend widely over the face and neck, and are then very superficial in character, and somewhat dusky in colour, constituting the 'port-wine stain.' If cut into, they bleed freely, but the hæmorrhage is easily stopped by pressure.

Occasionally a nævoid development may be observed involving half the body, and limited almost exactly by the middle line; this condition is known as *nævus unius lateris*. It may consist of a purely vascular manifestation, or the skin may be hypertrophied and covered with small soft papillary excrescences.

Treatment is usually simple in the extreme. Small superficial nævi can be completely cured by some form of cauterization, such as the application of the electric or actual cautery, ethylate of soda, or nitric acid; in applying fluid caustics, the surrounding skin must be protected by a thick layer of vaseline. In exposed situations electrolysis (*vide infra*) is the best plan to adopt in order to prevent the formation of a scar, but excision will often give an equally good result.

The **Cavernous or Venous Nævus** most commonly involves both skin and subcutaneous tissues, but is sometimes purely subcutaneous. It consists of a more or less prominent swelling, soft to the touch, and easily compressible, but refilling when the pressure is removed. There is no pulsation or bruit, and the mass may be lobulated. If subcutaneous, the skin over it is somewhat bluish in colour, but the mixed forms are dusky red. Occasionally it may undergo spontaneous cure from inflammation and thrombosis, and cysts are sometimes found in the centre of a nævoid mass, indicating that a partial attempt at this process has occurred. Venous nævi consist of a collection of vascular spaces lined with endothelium, some tubular like veins or capillaries, others mere pouches, held together by fibrous tissue. The arterial supply is not very great, but the arteries usually open directly into the venous spaces without the intervention of capillaries (p. 198).

The **Treatment** is by no means as simple as in the former variety. The following plans may be mentioned:

1. **Excision** of the growth should always be adopted where practicable. Cases which formerly were dealt with by strangulation are now treated by this means. The bleeding is never great, even if the nævoid tissue is encroached upon by the knife, and only a few vessels will need to be tied. Circular growths should be removed by crescentic incisions, and a little undercutting will usually enable the edges to be easily approximated. In exposed situations Halsted's subcuticular suture should be employed.

2. The **Injection** of coagulating and irritating fluids, such as per-

chloride of iron or pure liquefied carbolic acid, has been employed, but has no advantages over electrolysis, and is more risky and less certain in its results.

3. Where excision is impossible, or where it is important to leave no scars or only minute ones, **Electrolysis** should be employed. It consists in the passage of a current of high electromotive force through the mass, producing chemical and physical changes in the contained blood. A Stöhrer's battery can be used, or any suitable collection of cells, connected in series. Both needles may be inserted into the mass, but it is sometimes wiser only to introduce one or more needles connected with the positive pole, whilst the negative pole is attached to a large electrode moistened and placed on some indifferent part of the body, such as the arm, back, or thigh. The needle is often with advantage made of iron or steel, since it is usually corroded, and the chloride of iron thus formed acts beneficially in determining coagulation of the blood; it must be carefully and thoroughly insulated when deep nævi are treated, so as to protect the skin and prevent the current passing through it. The use of the negative pole is more likely to produce scarring, since a caustic sodium compound is formed around it, and this may lead to sloughing of the tissues; the clot, moreover, is loose and spongy, whilst a much firmer coagulum occurs around the positive pole. If the positive pole alone is introduced, a current equal to about 200 milliampères, as measured by a galvanometer, may be passed for ten or fifteen minutes; if both poles are used, a current half this strength is sufficient. An anæsthetic is needed, and the immediate effect should be to make the mass feel hard and firm by the coagulation of the blood; organization of the thrombus leads to obliteration of the vascular spaces and disappearance of the tumour. The application may require to be repeated several times, and the needles should be freely worked about through the mass. Not uncommonly the child becomes pale and faint if the nævus is on the head, probably as an effect of the strong current upon the cerebral centres. For the treatment of superficial nævi, there is no necessity to have the needle coated; it is introduced into the mass in a number of places, especially where any definite vessels are seen, and of course does not penetrate deeply. A very short application of the current usually suffices at each puncture; the nævoid tissue turns white, and there is a little bubbling of gas around the needle. It is best to deal first with the periphery of a nævus, and then, when its extension is arrested, the central parts can be treated. Of course, some scarring cannot be avoided, and hence it is wise not to do too much at one sitting, and to make the intervals sufficiently long to allow cicatrization to take place.

A **Nævo-Lipoma** is the name given to a somewhat rare tumour, in which a fatty element is blended with nævoid tissue. It is usually of congenital origin, or, at any rate, appears early in life, and is probably due to the undifferentiated formative cells of the embryo developing in a twofold direction, so as to produce not only fatty connective tissue, but also vessels. It gives rise to a swelling,

lobulated and doughy, like a fatty tumour, although it is usually little denser in texture than the ordinary lipoma. It may be possible to reduce its size by compression, but no thrill or pulsation can be detected; a few dilated veins or capillaries are often seen on the surface. The only treatment is excision.

Venesection.

Venesection or phlebotomy is a means of treatment which has largely fallen into disuse of late years, but is still occasionally employed with benefit. When a patient is becoming cyanosed, and asphyxia is threatening either (*a*) as a result of pulmonary engorgement from mitral incompetency, owing to the heart being unable to drive the blood into the systemic circulation; or (*b*) as a consequence of some accident involving the chest-wall and lungs, whereby the blood-aërating surface is so diminished that it cannot deal with the blood reaching it through the right side of the heart, which hence

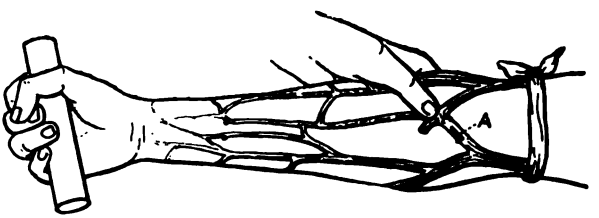


FIG. 99.—VENESECTION.

becomes enormously distended, and threatens to stop in a condition of diastole: or (*c*) where inflammation of the brain is pending, and the pulse is hard and full; or (*d*) in many inflammatory states in strong, full-blooded individuals where the pulse-tension is high—in any of these conditions venesection may be used with advantage.

The median basilic vein at the bend of the elbow is that usually opened, since it is larger than the median cephalic, though placed more directly over the brachial artery, from which it is only separated by the bicipital fascia.

Requisites.—A strip of bandage about 4 feet long; a lancet; a graduated bleeding-bowl; and finally a stick or bandage to be grasped by the hand, so as to cause contraction of the muscles, thus pressing the blood from the deep into the superficial veins along the communicating branch which enters the median just below its bifurcation.

Operation.—The patient should be seated in a chair; standing would produce syncope too rapidly, whilst the recumbent posture would allow too great an abstraction of blood before Nature's danger-signal (*i.e.*, syncope) is evident. The skin in front of the elbow having been purified, as also the fingers of the surgeon and the lancet, the bandage is tied round the arm with sufficient tight-

ness to arrest the venous circulation whilst the arterial supply is unimpeded. Grasping the stick firmly causes the veins to become prominent. The median basilic is now steadied by the left thumb, and an incision made into it (Fig. 99, A). Blood will flow from it in a full stream, and is collected in the bowl. When sufficient has been withdrawn, the stick is removed from the patient's hand, the surgeon's thumb is placed over the bleeding spot, the bandage above is relaxed, and a pad of antiseptic dressing placed over the wound and firmly bandaged in position; the arm is kept at rest for a few days to allow the small incision to heal. Occasionally neuralgic pain is caused by the implication of some of the fibres of the internal cutaneous nerve in the cicatrix; whilst, if the lancet is plunged too deeply, an arterio-venous wound may be produced.

CHAPTER XIV.

DISEASES OF THE LYMPHATICS.

Affections of Lymphatic Vessels.

Acute Lymphangitis, or Inflammation of the Lymphatic Vessels, n almost invariably from the absorption along the lymphatics fr impure wound of septic material, which gives rise to irritatio inflammation of the surrounding tissues, and this may run suppuration. The process is usually limited by the nearest lym glands, which filter off the toxic products, but occasionally it sp beyond them, and causes a true septicæmia. Dissecting or mortem wounds are not unfrequently of this nature.

Morbid Anatomy.—The walls of the lymphatics become hype and infiltrated, and the tissues around are inflamed. The lym said to coagulate in the vessels, forming a pinkish clot.

Clinical Signs.—The characteristic appearance is that of fi lines or streaks following the course of the lymphatics, perha to the nearest glands; the parts thus inflamed are tende œdematous. If the mischief is limited to the main trunks (*lymphangitis*), these red lines remain isolated from each othe if all the smaller lymphatic channels of a part are affected (*lymphangitis*), the redness merges into a generalized blush, a condition is practically identical with cellulitis. Localized suppuration often follow, the redness increasing and the pa coming dusky and brawny, until finally the centres softe fluctuate. These phenomena are associated with fever and m the temperature rising to 102° or 103°, possibly attended by vomiting, and diarrhœa.

Under suitable treatment resolution rapidly follows, but su tion may occur either in the glands or in some loose mass of c tissue traversed by the lymphatic trunks, or as a chain of ab in the course of the vessels. Occasionally the lymphatic become permanently occluded, and a form of solid or lym œdema results. Recurrent attacks of this type are not unco in connection with chronic eczema or ulcers of the leg, and m to a form of elephantiasis. In a few cases the patient die general septicæmia, or from exhaustion following diffuse supp

Treatment is first of all directed to the causative focus, which must be thoroughly purified, so as to cut off the supply of irritating toxins to the lymphatics. The limb itself is kept at rest in a slightly elevated position, and either irrigated with cold lotions, or treated with belladonna fomentations. Abscesses are opened as soon as they develop. Any subsequent œdema of the limb is remedied by massage and firm bandaging, provided no venous complications are present.

Constitutional treatment consists in the administration of a purge, followed by quinine and tonics, care being taken that constipation is not thereby produced. A light and nutritious diet is ordered, together with stimulants, if necessary.

Chronic Lymphangitis either results as a sequela of an acute attack, or is met with as a separate condition. It is most frequently seen in connection with venereal disease, the dorsal lymphatics of the penis becoming enlarged, hard, and cord-like, especially in cases of primary syphilis. This is usually accompanied by a solid œdematous condition of the prepuce and enlargement of the inguinal glands. Under appropriate antisyphilitic treatment, the swelling quickly subsides.

A *tuberculous* type of chronic lymphangitis also exists in which a primary focus, say, on a finger is associated with secondary deposits along the lymphatics up the arm. Each nodule is at first of firm consistency, but gradually softens and breaks down. Naturally, such a case is liable to be followed by general dissemination. The *treatment* consists in the excision, if possible, of each focus.

The cheeks and nose are occasionally the seat of a chronic relapsing lymphangitis, due to the absorption of sepsis from sores or ulcers within the nostril. It is characterized by patches of hyperæmia and some amount of tissue infiltration, and for its cure the causative sores must be dealt with. The thick lips of a tuberculous child are of a similar nature, and due to the constant irritation of cracks along the lip margin.

Rupture or Division of the Thoracic Duct during operations on the neck is manifested by an escape of chylous fluid, which coagulates on standing; if the flow continues, exhaustion quickly follows. Cases, however, have been published showing that the condition is not necessarily fatal, and that if the wounded vessel can be secured, as by ligature or forcipressure, recovery may ensue. In such instances the thoracic duct probably opens by several mouths into the subclavian vein, and only one of the branches has been injured.

Lymphatics, like bloodvessels, are liable to distension and dilatation, which may be either congenital or acquired, and are known as **Lymphangioma** or **Lymphangiectasis**. It is impossible to draw an absolute line of distinction between the two conditions, but the latter term is applied mainly to cases where normal lymphatics are dilated and their continuity with the normal lymphatic circulation persists, whilst a lymphangioma is the result of a new formation. Of course, the two conditions may develop side by side.

Lymphangiomata * are growths composed of newly-formed lymphatics, together with a variable amount of connective tissue, which is sometimes of a markedly fatty nature. They may be congenital or acquired, but even in the latter case there is probably some underlying congenital element, which was only awaiting some irritation or localized injury to determine its development. Two varieties may be described, the capillary and cavernous.

(*a*) The **Capillary Lymphangioma** is usually congenital in origin, but often increases considerably as the child grows, and may attain large proportions. When developing in the skin, it may be termed a **lymphatic nævus**, and in origin and development it well merits the title. The patch is usually of a dull yellowish-brown colour, but this varies with the amount of blood present; it may be smooth-topped like a wheal, or warty in appearance, but on examination with a lens each projecting point contains a vesicle. This type of growth is sometimes very extensive, and may be associated with tumours of the underlying connective tissues. We recently removed a large fatty mass from the anterior thoracic wall of a child, the greater portion of the projecting surface of which was covered with a capillary lymphangioma. The only *treatment* for this condition is excision or destruction by a caustic.

In the subcutaneous tissues the capillary variety is often associated with large cysts of the cavernous type. It constitutes a soft swelling which when cut into has a spongy texture and exudes a large amount of lymph, with some blood. This form is rarely well defined, and may burrow widely, invading and infiltrating the tissues, and, indeed, in some cases may almost be looked on as of a malignant nature. Free excision is the only cure.

(*b*) **Cavernous Lymphangioma.**—The lymphatics here lose their tubular condition and give rise to cyst-like swellings which vary much in size.

In the skin they are rarely larger than a split pea, and may co-exist with the capillary variety. Any part of the body may be affected, and the lesion manifests itself as a series of small vesicles, which persist and are unaccompanied by any inflammatory redness, thus serving to distinguish it from herpes. They contain lymph, and, if opened, a considerable flow of this fluid (lymphorrhœa) may result, lasting for some time. They have been observed most frequently on the inner side of the thigh and on the prepuce. **Treatment** consists in excision, or in laying them open and cauterizing the base.

In the deeper structures large multilocular cystic swellings may be produced: these are most frequently seen in the neck, and the condition is often termed a **Cystic Hygroma** (Fig. 100). The description given in Chapter XXXI. would apply equally well to a tumour of this nature in any other part of the body. Removal by dissection is often very difficult, especially in old-standing neglected cases; the limitations of the mass are sometimes very indefinite, and it may be

* See Carless, 'Some Cases of Lymphangioma,' *Brit. Journ. of Children's Diseases*, February, 1904, p 56.

necessary to leave the wound open and pack it, so as to ensure healing by granulation.

Lymphangiectases are more frequently acquired than congenital, but the latter condition occurs, and is then probably due to some abnormal development of the lymphatics or to ante-natal inflammatory mischief.

Macroglossia and **macrocheilia** are congenital enlargements of the tongue and lip, due to lymphatic obstruction and to an associated overgrowth of the connective tissues of the parts.

In a few cases the opening of the *thoracic duct* has been obstructed or compressed, leading to such backward tension that the receptaculum chyli has ruptured and the peritoneal and pleural cavities have been filled with a serous or chylous exudation. Virchow described one case where the opening was congenitally absent (in a calf) and the lymphatics throughout the body were enormously distended, especially those of the small intestine.

The condition known as **Chylous Hydrocele**, in which there is an effusion of milky fluid (presumably chyle) into the tunica vaginalis

FIG. 100.—CYSTIC HYGROMA OF NECK. (FROM A PHOTOGRAPH.)

The patient was a child of a few weeks. The cyst was opened and the mass partially removed. Recurrence ensued, and a further operation of a very extensive character was required. As the lymphangiomatous tissue had invaded the sterno-mastoid and parotid gland, it was impracticable to remove it totally. The child finally succumbed to septic lymphangitis and exhaustion.

is probably due to some such obstructive cause. In a case under our care the lymphatics of the spermatic cord were dilated by a similar fluid in a beaded manner.

Elephantiasis is a hypertrophic condition of the subcutaneous tissues and skin resulting from chronic lymphatic obstruction. Two chief varieties are described: (i.) *E. arabum*, due to a development in the lymphatics of living parasites, viz., the *Filaria sanguinis hominis*; (ii.) the *non-filarial* type, which may arise from many causes, such as the deposit of tuberculous or cancerous material in lymphatic glands; the obliteration of lymphatic channels in operations for removing such glands; recurrent attacks of lymphangitis in cases of chronic eczema or ulcer, leading to a gradually increasing obliteration of lymphatics. The condition generally affects the legs, but the scrotum

is not uncommonly involved, and occasionally the mammæ, arms, or face. The accompanying illustrations (Figs. 101 and 102) indicate that the non-filarial type may be just as severe as the other, although this is unusual.

Three chief phenomena manifest themselves as the outcome of such obstruction, viz., (*a*) ***Solid or lymphatic œdema***, a condition in which the subcutaneous tissues become firm, infiltrated, and brawny, but the fluid cannot be expressed from them, as in an ordinary œdema; (*b*) ***hyperplasia*** follows, affecting not only the subcutaneous tissues, which are markedly thickened and increased in amount, but

FIG. 101.—NON-FILARIAL ELEPHANTIASIS OF BOTH LEGS.
From a woman who had never been out of England. The cause was not apparent, but had been in action many years.

also the skin, which becomes coarse and wart-like in appearance. (*c*) The warty stage is usually preceded by a development of vesicles (dilated lymphatics) in the papillæ, and from these when ruptured a considerable flow of lymph (*lymphorrhœa*) may follow. If sepsis supervenes, chronic ulceration and recurrent lymphangitis may follow.

The pseud-elephantiasis arising from chronic ulcers, or from disease of the lymphatic glands, can usually be dealt with by the pressure of an elastic bandage; but the limb is very likely to remain permanently enlarged, and in some cases where intractable ulceration and lymph fistulæ exist amputation is the best treatment.

Elephantiasis Arabum (*syn.*: **Barbadoes leg**) requires but little notice

here, as it is seldom seen in this country, being mainly limited to the tropics, especially the West Indies and South America. The legs, scrotum, and vulva are the parts most frequently attacked, but the face or breast may also be affected. It manifests itself as a hyperplasia of variable size of the subcutaneous tissues, whilst the skin becomes thickened and wart-like, and from it a copious discharge of lymph may escape. The parts sometimes attain enormous dimensions, the scrotum even reaching to the ground when the patient is

FIG. 102.—NON-FILARIAL ELEPHANTIASIS OF SCROTUM, PENIS, AND THIGHS. (FROM A PHOTOGRAPH.)

The patient was a young man, and the cause of the trouble suppuration of the inguinal glands after scarlatina; the cicatrices of the incisions required in order to deal with the glands are plainly to be seen. The scrotum was much enlarged and very solid; the skin over it was covered with papillomatous growths, due to lymphatic dilatation. The skin of the penis was much thickened, and the subcutaneous tissues infiltrated. Over the thighs were scattered numbers of vesicles, which, when pricked, exuded lymph, and some of these were becoming transformed into solid fibrous growths. The legs and feet were also in a condition of solid œdema.

sitting. The disease persists for many years, and is not directly fatal.

The condition is due, as already mentioned, to the obstruction caused by the development of the *Filaria sanguinis hominis* in the lymphatics. These are spread (according to Manson) by the agency

of mosquitoes, in whose bodies the intermediate stage is passed. The dead mosquito, with its parasitic contents, falls upon the water, and in this way the ova find an entrance into the human stomach, where the young worm is set free, bores through the gastric mucous membrane, and finally becomes lodged in the lymphatics, especially those of the extremities. Not more than two or three pairs of mature filariæ are generally present in the same individual. The body of the female worm (which attains a length of 3 inches) is mainly occupied by the reproductive organs, and a countless number of embryonic filariæ are produced. Some remain coiled up in the lymphatic spaces, and give rise to the phenomena of lymphatic obstruction. Others become uncoiled, and are then about $\frac{1}{80}$ inch in length; they find their way into the blood-stream, sometimes at night (*F. nocturna*), sometimes in the day (*F. diurna*), and can be readily seen under the microscope (p. 52). Manson claims that they are taken into the body of the mosquito with the blood which it abstracts, and thus a fresh generation is developed.

The **Treatment** is extremely unsatisfactory. Of course, if one can localize the situation of the parent filariæ, as has been possible in a few cases, they should be excised; but even then the lymphatic obstruction may persist. Mr. R. J. Godlee has treated several cases where the leg was affected by dissecting out the dilated lymphatics in the groin and implanting them into a tributary of the internal saphena vein, so as to relieve the limb of its engorgement with lymph, a process facilitated by elevation of the limb and the use of elastic bandages; the results have been encouraging. In other parts of the body one has to depend on less satisfactory measures. When the face or trunk is involved but little can be done. When the scrotum is affected, the morbid tissue can be freely dissected away, sufficient skin being left to cover in the wound if possible; the penis and testes must first be isolated, and then the scrotum amputated, a tourniquet being used to restrain the bleeding. Similarly, in very old-standing and aggravated cases of elephantiasis of the leg amputation may be the only resource.

Affections of Lymphatic Glands.

Acute Lymphadenitis, or Inflammation of Lymphatic Glands.—The Cause of this condition is almost always the absorption of some irritative material (toxic or infective) from the periphery. When a part becomes inflamed, there is always an increased flow through the efferent lymph channels, owing to the exudation; the result of this is an increase in size of the glands to which the lymph is carried, which quickly subsides when the inflammatory process is at an end. If, however, irritating toxins are produced in the inflamed area, they give rise to a more prolonged and serious affection, whether accompanied or not by a similar condition of the lymphatic vessels. When pyogenic organisms are also absorbed, suppuration almost invariably results. In fact, the lymphatic glands must be looked on as the filters by means of which Nature eliminates many sources of disease.

es, is always associated with it, even in the early stages; the r may be of little importance, but when the capsule has given it may become so extensive as to constitute a diffuse suppurative litis.

nically, the glands can be felt as enlarged, tender, and rounded ses, the skin over them being red and œdematous; when pus has ed, the swelling, which is at first hard and brawny, becomes soft fluctuating. They early contract adhesions to neighbouring ues, and suppuration may extend widely beyond the glands, cially where there is much loose areolar tissue, as in the axilla. er, malaise, and all the general phenomena associated with an te inflammation, are usually well marked.

he **Treatment** consists, in the first place, in the removal of all rces of irritation, both physical and physiological. The part must kept at rest and protected from injury, and the offending wound causative lesion dealt with by such antiseptic measures as may be ded to hasten its restoration to a healthy state. Fomentations or ultices are applied over the gland, and the patient, after the ninistration of a purge, may be given quinine and iron, if necessary. soon as pus has formed, it should be let out by an incision, and wound dressed antiseptically.

Special Forms of Acute Lymphadenitis.

he **Axillary Glands** are usually affected as a result of poisoned wounds of the nd or fingers, although other glands exist lower down in the arm, viz., the epicondyloid, just above the internal condyle. Boils in the axilla and excoriaons or septic wounds of the breast may also cause an axillary abscess. In this ion a suppurative peri-adenitis is often superadded, extending widely under l between the pectoral muscles, reaching even up to the clavicle. Care must taken in opening such an abscess to avoid the main vessels by cutting from ve downwards, midway between the anterior and posterior axillary folds, ast Hilton's method should be adopted in all cases where the pus is situated ply.

n the **Groin** there are three groups of glands: (1) The oblique set, running

Suppuration in the glands of the **Neck** is exceedingly common, arising most often from affections of the scalp (eczema or pediculosis), ear (otorrhœa or eczema), throat, or lips. As to the exact distribution of the lymphatics, we must refer students to anatomical textbooks. When opening a cervical abscess, care must be taken to avoid important structures, such as the external jugular vein, and to make incisions across the fibres of the platysma in order to gain space for efficient drainage.

Chronic Lymphadenitis.—Three varieties of chronic inflammation of lymphatic glands are met with, viz., the simple, syphilitic, and tuberculous.

1. **Chronic Simple Lymphadenitis** is a condition resulting from some peripheral irritation, which is insufficient to cause an acute attack. It also occasionally results from blows and strains, as in over-walking, being in such cases possibly due to obstruction to the lymphatic flow, owing to compression or rupture of the efferent vessels. The glands become enlarged, tender, and painful, but as a rule they do not become adherent to one another, or to adjacent structures, and show but little tendency to suppurate. This condition often precedes, and, indeed, may be looked on as a predisposing cause of, tuberculous lymphadenitis. The **Treatment** consists in keeping the part at rest, removing if possible all sources of local irritation, combined perhaps with the local application of iodine paint or friction with iodide of potassium or iodide of mercury ointment. The general health should also be attended to, especially in children predisposed to the development of tuberculous disease.

2. **Chronic Syphilitic Lymphadenitis.**—The lymphatic glands are involved in several ways in the course of syphilitic disease: (*a*) The primary lesion is associated with the development of an indolent bubo in the nearest lymphatic glands, which become hard, somewhat like almonds or bullets beneath the skin. But little pain is noticed unless suppuration is taking place; this is never due to the syphilitic virus alone, but to the absorption of some septic matter from the primary lesion. There is usually much more enlargement of, and infiltration around, glands in extragenital chancres than in those occurring about the genital organs. (*b*) In the second stage, when general infection has occurred, the glands in many parts of the body are affected in the same indolent fashion. (*c*) In the tertiary period the lymphatic glands may undergo a true gummatous change, or become enlarged and tender owing to the absorption of septic material from a broken-down gumma. For further particulars and **Treatment**, see p. 141.

3. **Chronic Tuberculous Lymphadenitis** occurs most commonly in children or young adults who have inherited a predisposition to the development of tuberculous disease, and more especially in those whose surroundings are unhealthy, and whose general condition is deteriorated by insufficient or bad food and want of fresh air. Some local focus of irritation is usually present in the form of pediculosis capitis, decayed teeth, chronic otorrhœa, adenoids, or eczema of the face. As a result of this, neighbouring glands become chronically inflamed, and, as Sir T. Burdon Sanderson says, 'the soil is thereby prepared for the seed.' The bacilli are conveyed to the gland by

the blood or lymph, gaining access through some breach of surface, or even perhaps through a healthy mucous membrane, or perhaps they may be derived from some deep focus of quiescent tubercle, say, in the bronchial or mediastinal glands, a situation in which tubercle is often unexpectedly found. Any lymphoid tissue in the body may become the seat of tuberculous disease; but the glands of the neck, especially the submaxillary and the concatenate, are much more commonly involved than any others. The axillary and inguinal glands are also not unfrequently affected, whilst tuberculous disease of those in the mesentery gives rise to the affection known as 'tabes mesenterica.'

The course of the case may be described under the following headings, although it must be remembered that the stages do not necessarily follow one another in exact sequence: (i.) The earliest manifestation of the disease consists in a *fleshy enlargement* of the glands, which cannot at first be distinguished, either clinically or pathologically, from a simple chronic hyperplasia. The gland may be enlarged to many times its natural size, and on section looks pinkish in colour, and is of firm consistence. Microscopically, all that is noticed is a great increase in the lymphoid corpuscles, together with some overgrowth and thickening of the fibrous capsule and trabeculæ. When tuberculous infection has occurred, the characteristic nodules can be seen under the microscope, but there is at first no change in the naked-eye appearances. (ii.) *Caseation* follows sooner or later, and since the tuberculous nodules are often disseminated widely through the gland, many caseating foci will be found. (iii.) *Calcification* of the caseous detritus sometimes occurs in those cases which are tending to recovery. Such is accompanied by a fibroid thickening of the gland, resulting from overgrowth of the capsular and trabecular connective tissue. This change is most frequently observed in the mediastinal and mesenteric glands, and is not very uncommon in the neck. (iv.) More frequently *suppuration* ensues, sometimes from a simple emulsification of the caseating material, sometimes from a superadded infection with pyogenic organisms. Foci of pus develop at various spots in the glandular parenchyma, and when once formed, these tend to amalgamate and cause the destruction of the rest of the glandular tissue, the fibrous trabeculæ remaining longest unaffected, so that finally the gland is represented by a single abscess cavity surrounded by a pyogenic membrane of the ordinary tuberculous type, in which traces of the capsule can be observed. Several of these abscesses may unite one with another, and thus a large multiloculated cavity, containing pus mixed with curdy débris, is formed. (v.) A certain amount of *peri-adenitis* is almost always present, though not to any great extent in the early stages; when, however, suppuration has occurred, or if the glands are exposed to pressure or friction, they become adherent not only to neighbouring glands, but also to surrounding structures. In the more chronic cases the fibro-cicatricial tissue thus formed may be so extensive as to fix the mass firmly to the deeper parts, such as the main

vessels and nerves, rendering removal by enucleation dangerous almost impracticable. Important vessels are occasionally eroded an extension of the suppurative process, and this may lead to f hæmorrhage. (vi.) Sooner or later the abscess, if left to itself, bu either at one or several spots, leaving ulcerated openings, thro which is seen œdematous granulation tissue mixed with caseo material. The edges are undermined, thin, and purplish, and granulations sometimes sufficiently prominent to protrude thro the openings as fungating masses. A variable amount of pus esc from these, and the condition may persist for many years if rad treatment is not undertaken. (vii.) Under suitable local and const tional measures these sores may, and usually do, heal after a ti giving rise to a pulpy spongy *cicatrix*, which is often puckered more or less keloidal, and may retain its vascularity for a much lon period than would a healthy scar. Lymphatic œdema in the reg drained by the affected glands is sometimes observed as a late con quence of this affection.

The usual **complications** met with in the course of all tuberculo diseases may also manifest themselves (p. 165).

The **Treatment** of tuberculous glands is palliative or radical.

Palliative Treatment consists mainly in improving the gene health by means of suitable diet and tonics, such as cod-liver-oil a syrup of the iodide of iron, together with residence in a healt bracing situation, especially at the seaside, as, for instance, at Marg All sources of local irritation must be removed so as, if possible, prevent infection with pyogenic organisms, and counter-irritants, s as iodine paint, are best avoided. *Rest* of the affected part should enforced as much as possible; in some cases the application of spli to restrict movement is advisable.

Radical Treatment.—Wherever practicable, glands evidently tub culous should be completely removed by dissection, and even amon the wealthy too much time should not be wasted in palliative measu inasmuch as the longer the glands are left, the firmer will be adhesions which they are likely to contract with surrounding tiss In the later stages, so far may this process have gone that remo by dissection is hopeless. In such cases a free opening is made d to the diseased tissues, and as large a portion removed as possi whilst the remaining deeper parts are scraped with a Volkma spoon. The wound can rarely be entirely closed, and must be pac with gauze soaked in an iodoform emulsion (10 per cent.), and allo to heal by granulation. In septic cases the same line of treatm must necessarily be adopted.

In the *neck* very extensive operations may have to be underta for the removal of tuberculous glands. The incision varies with situation of the mass, but every effort must be made to minimize deformity and scarring. In the upper part of the neck, when glands lie in front of the sterno-mastoid, an almost transverse inci may be employed, or one following the creases of the skin and similar to that for ligature of the lingual artery (Fig. 103, B).

e lower half of the neck an incision along the anterior or posterior rder of the sterno-mastoid (E) will often suffice, or if the glands tend backwards a transverse one just above the clavicle (A^1).

When enlarged glands are present both in front of and behind the sterno-mastoid, well as beneath it, their removal is perhaps most satisfactorily accomplished r a method suggested by Halsted. The incision commences close to the tip of e mastoid process, and, passing forwards just behind the jaw, sweeps across e neck to the middle of the clavicle (Fig. 103, A); a second incision runs ansversely just above the clavicle (A^1). The flaps thus marked out are dissected p so as to lay bare the sterno-mastoid and the enlarged glands. The deep issection commences from below and behind. The supraclavicular triangle is irst cleared, the omo-hyoid muscle being divided, but sutures are left on the ends ior identification. The anterior end is drawn up, and serves to raise the sterno-mastoid, which is then divided obliquely (D) below the spinal accessory nerve (C).

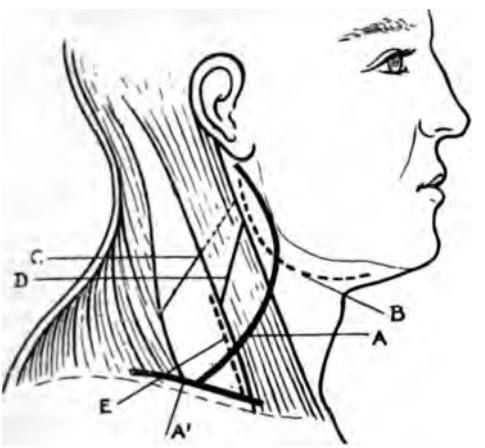


FIG. 103.—INCISIONS FOR REMOVAL OF TUBERCULOUS GLANDS FROM THE NECK.
and A^1, For removal of glands from both triangles (Halsted's method); B, for removing glands from submaxillary and upper carotid regions; E, for removing glands in lower part of posterior triangle; C, spinal accessory nerve; D, site for division of sterno-mastoid.

divided ends are turned up and down so as to expose freely the glands lying e carotid sheath, which are dealt with from below upwards. Special care be taken of the nerves and of the internal jugular, but it is better to tie and e this structure than to leave it in the wound with a number of lateral es applied. During the vomiting that is almost certain to follow such an ive dissection, lateral ligatures would very possibly be forced off by the ly increased intravenous tension thereby induced. When all the glands en removed, the divided muscles are carefully replaced and sutured , and divided fasciæ, etc., approximated by buried sutures. In this, as eck operations, the skin is brought together by Halsted's intradermic od it is wonderful how little scarring and deformity follow this extensive e.

re-auricular gland, lying on the capsule of the parotid, is some- ected, and may cause facial paralysis, either as a result of the

sclerosing peri-adenitis, or from injudicious surgery. Any incisions made with a view to remove the gland or to open an abscess therein should be made in the direction of the fibres of the facial nerve, *i.e.*, horizontally.

In the *groin*, tuberculous glands are often mistaken for some condition due to venereal disease. The history of onset and the extreme chronicity should suffice to establish a diagnosis. The iliac glands will often be found similarly affected, and operations in this region are sometimes very extensive in consequence. Well-marked peri-adenitis is usually present in the iliac fossa, and the glands may be very adherent. Atrophy of the testicle sometimes follows, either from division of the spermatic vessels, or from their implication in the cicatrix.

Tumours of Lymphatic Glands.

The primary new growths occurring in lymphatic glands are **Lymphadenoma**, or Hodgkin's disease, **Lymphatic Leucocythæmia**, and **Lympho-sarcoma**. The subject has been greatly confused by the various names used by different writers, and by the fact that the same names have been used to denote very different conditions. Further, the structure of the growths in these three conditions is very similar, and their clinical histories have often a great resemblance, so that it is frequently a difficult matter to refer a given case to its proper group.

Lymphadenoma, Hodgkin's disease, or pseudo-leukæmia, is characterized by a progressive enlargement of the lymphatic glands and of the lymphoid tissue of the spleen, liver, and other organs. The affected glands and the masses in the viscera are quite characteristic in structure, and have a very different appearance from that seen in simple hyperplasia of the glands or in infective processes. The gland is homogeneous on section, the distinction between cortex and medulla being lost, and the whole of the gland being affected to the same extent, so that it is not possible, as in some malignant tumours, to distinguish between the actively growing and the older portions of the tumours. The lymphocytes are greatly reduced in numbers, so that the fibrous stroma of the gland becomes more obvious; if the latter is not very abundant the glands remain soft, but sometimes the stroma is much hypertrophied, and then the glands become hard. One type does not appear to pass into the other, and the soft form is, in most cases, more malignant and more rapid in growth than the hard.

Hodgkin's disease is most common in young adults, but no age is exempt; it is decidedly more common in males than in females. In some cases, as Trousseau pointed out, the cause of the first enlargement of glands is some inflammatory lesion, such as otitis media or dental caries, but usually no such origin can be traced. The glands first affected are usually superficial ones, and many become enlarged in one region before others are affected elsewhere, constituting a condition sometimes termed *benign or localized lymphadenoma;* the commonest group to be enlarged is the cervical, the axillary and inguinal being less often affected. In other cases the deep glands become enlarged

first, and this most commonly in the mediastinal group, the retro-peritoneal glands coming next in order of frequency. When the disease is more advanced adenoid tissue in any part of the body may be affected. The spleen is usually somewhat enlarged, and in about half the cases presents localized grayish-white tumours (the *hard-bake spleen*). Similar growths may occur in the liver, kidneys, etc., or in the skin.

The early symptoms are slight, the only thing noticed being the glandular enlargement. In this stage the glands are isolated, and not adherent to the skin or to one another; they have little or no tendency to caseate or suppurate. There may be slight irregular pyrexia, or a continuous fever, but no blood changes.

When the internal glands are first affected, the earliest symptoms may be those of pressure. This is most marked in the mediastinal group of cases, in which the symptoms are those of aortic aneurism or thoracic tumour. In particular, pressure on the superior vena cava is noted, leading to engorgement of the superficial thoracic veins.

In the later stages the glands often fuse together, forming hard masses of large size, and the disease becomes generalized. The blood shows a moderate grade of anæmia of the secondary type, with a slight increase of leucocytes, especially of the lymphocytes. The fever is more marked, and there is often severe itching.

Diagnosis.—(1) From *lymphatic leucocythæmia* (pp. 51, 370) Hodgkin's disease is recognized by the entire absence of blood changes in the early stages, and by the presence merely of a secondary anæmia in the later. Moreover, lymphadenoma usually limits itself to regions in which adenoid tissue is normally present; leucocythæmia may develop new growths in any part of the body. (2) From *lympho-sarcoma* it is known by the fact that it is almost invariably limited to the glands, and does not infiltrate surrounding tissues. Lympho-sarcoma is characterized chiefly by its tendency to infiltrate, and also by producing secondary deposits in tissues which are not rich in adenoid tissue. (3) From *tuberculous disease* of glands the diagnosis is often difficult. Tubercle is more common in the very young, and is more frequently bilateral. The glands have a greater tendency to become united to one another and to suppurate, even when of small size. In doubtful cases microscopic examination of an excised gland may be required to settle the diagnosis.

The *Treatment* of Hodgkin's disease is unsatisfactory. Arsenic in increasing doses is of the greatest value, and the glands should be excised whenever accessible, repeated and extensive operations being sometimes required.

Lymphatic Leucocythæmia is of little surgical interest except in so far as it simulates Hodgkin's disease. The symptoms in the two are practically identical, except that in the former there are marked blood changes: the leucocytes are vastly increased, reaching 150,000 or more per cubic millimetre, and there is a great preponderance of lympho-cytes, which constitute from 90 to 99 per cent. of all cells present. There is also anæmia, often of some severity (p. 51). Arsenic is valuable, and operative treatment useless.

Lympho-sarcoma.—This term has been used in very different sens by different writers, and is best restricted to tumours which have structure approximating to that of adenoid tissue—*i.e.*, which consi of small round cells, resembling, if not identical with, ordina lymphocytes. These cells are set in a reticulated stroma simil to that of the lymphatic glands, Peyer's patches, etc. These tumo approximate closely to the ordinary small round-celled sarcoma the only point of difference being the better development of t stroma in the lympho-sarcomata. They are recognised mic scopically by the fact that they invade and destroy the surroundi tissues, and by their structure, which resembles that of adeno tissue, but is devoid of any distinction between cortex and medul In some cases they are very difficult to distinguish from chro inflammatory material of granulomatous type.

Lympho-sarcoma may commence in any part of the body, but the vast majority of cases it originates in pre-existing adenoid tiss most commonly in the glands in the root of the neck, the tonsil, the mediastinum. It may also affect the intestines (commenc probably in the Peyer's patches) or in the testis. When commenc in a region where its development can be followed, it is seen to fo a rapidly-growing tumour, which is at first firm, elastic, and painle later on, however, as it increases in size, it becomes tender, and m cause great pain from pressure on, or implication of, nerves. early contracts adhesions to surrounding parts, and gives rise secondary growths in neighbouring glands by direct transmissi The superjacent skin is at first unaltered in colour and texture, as the tumour increases, it becomes congested and shiny, and c tains a network of dilated veins. Finally, it is involved in growth, and ulcerates, an occurrence usually followed by the spro ing up of a bleeding fungating mass, similar in character to t formed by any other rapidly-growing malignant tumour. Dissemi tion of the growth throughout the viscera follows, death result from exhaustion and cachexia.

The *Treatment* consists in the removal of the mass, where pr ticable, without delay. If, however, extensive adhesions exist, becomes absolutely impossible.

Secondary Growths in Lymphatic Glands are a special feature all cancerous tumours. In the sarcomata they are less comm but are always present in the case of melanotic sarcoma, lymp sarcoma, and usually in sarcoma of the testis, tonsil, and thyr The special characteristics of these are noted elsewhere.

CHAPTER XV.

AFFECTIONS OF NERVES.

Injuries of Nerves.

The simplest and most common forms of injury to which nerves are liable are **Contusions** and **Strains**, causing a sensation of tingling, or pins and needles, which usually wears off in the course of a few hours. In severe cases variable degrees of loss of power and sensation may ensue, and in hysterical women more or less neuralgia. In patients suffering from gout, syphilis, or rheumatism, a chronic peripheral neuritis is readily induced, often of a somewhat intractable type, and this even develops in healthy individuals. **Treatment** consists in gentle friction with stimulating liniments.

Rupture of nerves without an external wound only occurs in connection with severe injuries, such as dislocations or fractures, and even then total division is rare, the sheath retaining its integrity, although the axis cylinders may have given way. Immediate paralysis and loss of sensation usually follow, and may persist for a time, although repair not unfrequently occurs, since the sheath remains intact. The doubt always existing as to the condition of the sheath regulates the **Treatment** which must be followed, viz., one of expectancy. Friction and electricity should be applied to the parts, and only when these have failed should operation be undertaken. Secondary nerve suture under these circumstances is not a very successful proceeding.

Compression of a nerve is usually due to the growth of tumours or aneurisms, or to some displacement of bones, as in fractures or dislocations; or, again, the nerve may be included in the callus formed in the repair of a fracture—*e.g.*, the musculo-spiral, owing to its proximity to the humerus—the symptoms not appearing till four or five weeks after the injury; or it may be met with in the form of crutch palsy, or as a result of splint pressure, as when the external popliteal nerve is compressed against the neck of the fibula. Those nerves also which traverse bony canals in the skull are liable to pressure as a result of chronic osteitis and condensation of the surrounding osseous tissues. Patients who have suffered from syphilis are more liable to develop chronic neuritis from slight pressure than other individuals. The early symptoms are those of

irritation, *e.g.*, cramp and spasm of muscles or neuralgic pain; whil the later ones, due to more prolonged compression, are those o paralysis and anæsthesia, combined sometimes with trophic phen mena. If the compressing cause can be removed, recovery, at an rate of a partial character, follows in time under suitable treatmen such as massage, electricity, and the administration of iodide o potassium or nerve tonics.

Total Division of a Nerve.—The **Immediate Effects** are: (*a*) Paraly of the muscles supplied by the nerve; (*b*) complete anæsthesia o the parts supplied by it, which, however, is not necessarily permane since sensation may be conveyed by collateral trunks, the anæsthet area passing through gradual stages of partial sensation before r covery is complete. (*c*) Vasomotor paralysis is also produced, t limb becoming hyperæmic and warmer for a few days, and the subsequently colder and insufficiently supplied with blood. (*d*) Th excito-secretory nerves are paralyzed so that glands lose their fun tions for a time.

The **Secondary Effects** vary with the character of the nerve injure and are much more complicated than the former. We must discu them under five headings:

1. **Changes in the Nerve.**—*Locally*, the two ends retract very slightl perhaps not more than the twelfth of an inch, and the space th formed fills with blood, which is quickly absorbed and replaced b granulation tissue, and this in turn by a bulb-like mass of fibr cicatricial tissue (*traumatic neuroma*), within which are found spac filled with fine nervous fibrillæ coiled up in loops and developed fro the 'neurilemma cells, which, taking on an active neuroblastic fun tion, secrete short lengths of axis cylinders and of medullary sheath and these, linking themselves together into chains, form continuo axis cylinders and medullary sheaths.'* After an amputation, mo of the divided nerves are found to have developed these typic bulbous ends (Fig. 104), whilst in nerves accidentally severed their continuity the bulbous mass which forms on the upper end separated by an interval from the atrophied lower end, though the is usually a fibrous connection between the two. These bulbs a often the seat of severe neuralgia. In a few rare instances immedi union of a divided nerve is supposed to have occurred, as indicat by total and rapid restoration of function, but it is quite possible th the phenomena in question were due to a transmission of nervo stimuli by collateral nerve-trunks.

Peripherally, an almost immediate invasion of leucocytes occurs the result of the traumatism, and these are followed and replac after a few days by proliferated connective-tissue cells. The so-call Wallerian degeneration commences about the fourth day after t accident, in consequence of the separation of the nerve from trophic centres. It first shows itself in the medullary substan which undergoes a kind of segmentation, becoming broken up in

* See Ballance and Purves Stewart, 'The Healing of Nerves'; Macmil and Co., 1901.

irregular masses of myeline, which are absorbed by the connective-tissue cells, and disappear entirely in about a month. The axis cylinders also degenerate and disappear, being lost in the myeline masses. The neurilemma cells proliferate in columns and form a fibro-cellular mass, which represents the nerve, and has long lost all power of conducting nervous or electric stimuli, although attempts at regeneration are made at both ends.

FIG. 104.—TRAUMATIC NEUROMA OF POSTERIOR TIBIAL NERVE AFTER AMPUTATION OF LEG. (FROM KING'S COLLEGE HOSPITAL MUSEUM.)

Proximally, degeneration of the medullary sheath occurs, similar to that which is seen in the distal portion, but only extending as far as the next node of Ranvier. It is of but little significance.

2. **Changes in the Muscles.**—Complete paralysis of motion necessarily occurs when a motor nerve has been divided, and the muscles involved slowly atrophy and undergo degeneration. The atrophy is not noticed at first, and is not so rapid as that arising from infantile palsy, since it is simply due to separation from the trophic centres, and not to their destruction. As a result of the paralysis and atrophy, deformity may ensue, owing to a disturbance of the equilibrium normally maintained between opposing groups of muscles. The *electrical* changes, too, are exceedingly important. The faradic current rapidly loses its power over the affected muscles, and its effects totally disappear in two or three weeks, whilst the galvanic excitability remains for weeks or months, and even then only slowly diminishes, so that a condition develops in which the galvanic current produces a much greater contraction than the faradic (*reaction of degeneration*). As long as this phenomenon remains, there is a hope that restoration of the continuity of the nerve may be followed by restoration of function; but when the muscles react neither to galvanic nor to faradic stimuli, the case may be looked upon as beyond repair.

3. Various modifications of **Sensation**, both special, general, and muscular, may be observed.

4. The blood-supply to a paralyzed part is always diminished, so that it looks blue and congested, owing to the weak circulation; consequently, the temperature falls and the vitality of the part is decreased. This, associated with anæsthesia and the loss of trophic influence of the nerve-centres, results in certain conditions which may be of considerable importance. Thus, the skin becomes thin, atrophic, bluish-red, and shiny ('glossy skin' of Weir-Mitchell), or it may be rough and covered with scales, or even œdematous. Chilblains are readily produced, and any exposure to cold or heat may result in vesication

or even sloughing. Wounds heal badly, and ulceration from slight irritants is very likely to occur, *e.g.*, corneal ulceration after division of the fifth nerve, and perforating ulcers of the foot. The cutaneous appendages are also involved, the hairs falling out, the nails becoming rough, brittle, and scaly, and the sebaceous and sweat glands either discharging an abundant secretion, or remaining absolutely functionless. Atrophy of the smaller bones may follow, and ankylosis of the terminal joints of the fingers or toes. In a growing child the development of the part is always more or less impaired. The more exaggerated forms of trophic trouble just described only occur in irritative lesions of nerves, *e.g.*, when a foreign body is left in contact with them; simple section results merely in simple atrophy.

5. Finally, in a few cases changes have developed in the central nervous system which are of extreme interest. In the early stages reflex spasms or paralyses are sometimes met with as temporary phenomena; but at a later date more serious symptoms may result. Thus, in a glass wound of the median nerve, a healthy man treated at hospital developed a typical epileptic fit whenever the neuralgic bulbous end was touched. The bulb was excised, and the nerve cleanly sutured, but without effect, the epilepsy and pain still remaining. The median nerve was divided in the upper arm, and a portion removed, but without benefit. Finally, the patient passed into a condition of chronic dementia, and died, no obvious lesions being found on post-mortem examination.

Regeneration of a divided nerve must necessarily ensue if restoration of function is obtained. Attempts at regeneration are always evident in the distal segment, whether or not it has been sutured to the upper end, but in the latter case the phenomena are later in appearance and are never carried to perfection, owing to the intervention of the end-bulb. Considerable discussion has arisen as to whether the new axis cylinders grow downwards from the central end to the peripheral, or whether they are developed *in* the distal segment. The researches of Ballance and Purves Stewart certainly favour the latter theory. The proliferated neurilemma cells always retain their longitudinal direction, and about three or four weeks after the operation (a little later, if no operation) thin beaded threads begin to show themselves along one side of such a spindle-shaped cell, and, gradually growing downwards, stretch out towards their nearest neighbours. The union of these small segments constitutes the new axis cylinder, which is gradually covered in by a medullary sheath, also apparently the product of the neurilemma cells, and finally joins with the central end of the nerve. The process takes some months to reach completion. Clinically, the earliest evidence of regeneration is a slight return of sensation, which may be at first abnormal, and only slowly becomes of a normal type. Motion is generally much later in its restoration than sensation, and may never be entirely recovered. Under very favourable circumstances it is possible for an interval even as great as 1½ inches to be bridged over by this process, but such an event is very unusual. The use of a nerve-graft under these conditions may direct the energies of

the neuroblastic cells, but the graft is itself quite passive, being invaded by neurilemma cells from above and below.

The **Treatment** of a divided nerve depends upon its size and function. If small and of slight importance, no special treatment is required; but in any of the main nerves of the extremities it is essential to deal with them at once by **Primary Nerve Suture**. This is best accomplished by using a domestic sewing needle without cutting edges, or a fine Hagedorn needle, and the finest chromicized catgut; one or more stitches should pass through the nerve, and the rest merely through the sheath. Absolute asepsis is essential in order to obtain satisfactory results.

If the wound has been inflicted months before, and a bulb has formed, **Secondary Nerve Suture** must be employed. The nerve is first exposed by a free incision through the cicatrix, the two ends identified and isolated, and the fibrous tissue of the bulb removed to a sufficient extent to expose healthy nerve fibrillæ; the divided ends are then brought together with as little tension as possible. To fill up the gap resulting from removal of the bulb, traction upon each end of the nerve should be employed to stretch it, and the limb subsequently put up in such a position as to relax the parts, *e.g.*, the wrist flexed to a right angle, or the elbow bent (except when dealing with the ulnar nerve above the elbow, flexion of which increases the tension of the nerve). In one case we removed an inch or two of the humerus to allow the divided ends of the musculo-spiral nerve to be approximated. In order to diminish the drag on the fine end-to-end sutures, a tension stitch should be passed through the substance of the nerve, about ¼ to ½ an inch from the divided ends.

Nerve-grafting, in order to bridge over a defect, has not up to the present been found of much practical value, although a few cases of success are reported. A nerve similar in size to that to be operated on is removed from an animal just previously killed, and carefully stitched in position. Since it merely acts as a carrier to the neuroblastic cells, the same result would possibly be obtained by passing several fine strands of catgut from one end to the other.

Nerve anastomosis has been utilized in a few cases of facial paralysis and in a few other instances in order to restore movement. A suitably placed motor nerve is united to the trunk of the affected nerve, and in time motor phenomena have manifested themselves with some degree of benefit.

During the time that the paralysis continues the limb itself must be well massaged, the fingers or toes worked daily to keep them from getting stiff, and the muscles treated with electricity, and preferably by means of the electric bath, one electrode being placed in a basin of warm saline solution, and the other against the patient's back, and the affected limb then dipped in the water till it becomes of a bright-red colour.

In many cases where the original wound has been complicated with spreading septic inflammation the impaired mobility is as much due to the inflammatory adhesions of joints and tendons as to paralysis.

Inflammation of Nerves.

Acute Neuritis is not a very common condition. It is usual to injury, gout, or rheumatism, but is occasionally observed i nection with septic wounds. The nerve may sometimes be fel swollen or tender, whilst severe pain of a neuralgic type is complained of by the patient. On microscopic examinatic ordinary signs of inflammation are well marked, though i evident in the sheath. The **Treatment** consists of rest to the together with leeching or dry cupping over the course of the combined with belladonna fomentations and suitable g therapeutic measures.

Chronic Neuritis, or **Perineuritis**, is much more commo the former. It consists pathologically in an increase of t connective tissue of a nerve, both around it and between the fas with compression of the vessels and nerve-fibres. It may from injury, such as sprains, strains, or pressure, especially the patient is suffering from syphilis, rheumatism, or gout, i met with after influenza and in various toxic conditions, *e.g.*, al ism, diabetes, malaria, etc. It is very common in the fifth and in the branches of the brachial plexus. The **Symptoms** good deal with the nerve affected. Occasionally it can b thickened and tender on pressure, whilst more or less severe net is also noticed, accompanied, perhaps, by some loss of power muscles supplied by it. Trophic lesions may also be induced, s perforating ulcer, or ankylosis of the terminal joints of fingers c

The **Treatment** in the early stages consists in the adminis of antidiathetic remedies, and, indeed, iodide of potassium, w without mercury, is generally applicable. Locally, prolonged needed, with counter-irritation in the form of blisters, and la massage with suitable liniments. If there is any paresis, the m must be stimulated daily by the faradic current or electric Excessive pain is combated by administering hypodermically m or atropine. Failing these, other means should be adopted, s acupuncture, in which needles are passed into the substance nerve, and allowed to remain for a few moments; this probabl by relieving the tension and inflammatory exudation withi sheath. Various operative measures dealt with under neuralgi be called for in severe and protracted cases.

For **Tumours** of nerves, see p. 195.

Neuralgia.

Neuralgia is a condition which either the physician or the s may be called upon to treat; it is exceedingly common, and may of the most terrible afflictions to which the human frame is s It is characterized by a paroxysmal or intermittent pain of a d or stabbing type, which follows the course of some particular or nerves, especially the trigeminal. In this nerve the attack

mences suddenly, and the pain steadily increases until it reaches a climax, and then gradually or rapidly subsides. These paroxysms may last minutes or hours, and may recur at varying intervals, either a few in a day or many in an hour; they may be induced by sudden noises, a draught of air, etc. Moreover, pressure over the affected trunks may originate, relieve, or increase the pain, whilst the skin affected by them is often intensely tender, and even hyperæmic and œdematous (the *points douloureux* of Valleix). Occasionally adjacent muscles become spasmodically and sympathetically contracted during the attack, whilst excessive secretion, such as from the lachrymal or sweat glands, is also induced. Herpes is sometimes met with in the area of distribution of the affected nerve (*e.g.*, shingles in connection with intercostal neuralgia). Neuralgic manifestations may occur in any sensory or mixed nerve, such as the intercostals or sciatic, or in complex bodies, such as the breast, testis, or the larger joints.

The **Causes** of neuralgia are very diverse, and the surgeon often has to look far afield in order to find them. Thus, as *predisposing* causes may be mentioned the hysterical temperament, anæmia, and depressing circumstances of all kinds, especially mental anxiety and worry. The *direct* causes may be toxic, *e.g.*, malaria, influenza, lead, or mercury; reflex, *e.g.*, ovarian disease, worms, etc.; central, from disease of the spinal cord or brain; radical, from pressure on the nerve-roots as they emerge from the spinal canal or cranium; or peripheral, owing to lesions of the trunks induced either by trauma, inflammation, or new growths.

Treatment consists primarily in attention to the general health, and the local application of counter-irritants and sedatives. Iron and arsenic may be given to anæmic patients; anti-spasmodics, such as valerianate of zinc, to hysterical women; quinine or arsenic for malaria; whilst sea-bathing or change of air is often advisable. Iodide of potassium and mercury are beneficial in all cases due to syphilis. When the pain is excessive, morphia, even in large doses, may be required. Empirical remedies, such as antipyrine, phenacetin, menthol, and croton-chloral hydrate will sometimes do good.

When, however, medicinal agents fail, surgical measures are indicated in order to allay the patient's sufferings. The following are the more usual methods adopted:

1. **In purely Sensory Nerves**, such as the trigeminal, simple division or *neurotomy* has often been resorted to, but the relief gained is of a most temporary nature, since sensory nerves readily unite after division, and sensation is rapidly restored even when union is incomplete, probably by transmission through collateral branches; hence the operation has fallen into discredit. A more satisfactory proceeding is *neurectomy*, or the removal of a portion of the nerve-trunk, which does temporary good even in cases due to central causes, probably by placing the centre in a condition of rest through the exclusion of afferent stimuli. As large a portion of the affected nerve should be removed as possible, and Thiersch suggested a plan of *nerve extraction* in which the trunk is laid bare at a suitable spot, and then grasped with forceps and twisted out.

Finally, if all such measures have failed, the roots of the nerves may be divided either within the skull or in the spinal canal, or the ganglia connected with their roots may be removed.

2. **In a Mixed Nerve**, conveying motor as well as sensory stimuli, *nerve-stretching* has to be mainly relied upon. The trunk is laid bare, and traction exercised, both centrally and peripherally, by means of a blunt hook if the nerve is small, or of the finger placed under it if large. The clinical effect is to abolish the conductivity of the nerve for a time, either completely or partially; but since it is not divided, repair and restoration of function follow. The elasticity and extensibility of the nerves are considerable, and the force needed to cause their rupture has been accurately estimated. It varies much in different individuals, and allowance must be made for this in all operations. Thus, the sciatic nerve will stand about as much traction as an ordinary man can make with his finger and thumb; it should be applied steadily and continuously, not in a series of jerks. The effect of stretching is to free the nerve from external inflammatory adhesions, and to alter the relations between the sheath and its contents. The perineurium has its fibrillæ, which are naturally wavy, straightened out, thereby compressing the lymphatic spaces between the fibres, and possibly rupturing the nervi nervorum. The nerve becomes hyperæmic, and the medullary sheath of the tubules may be irregularly broken up.

Affections of Special Nerves.

The Cranial Nerves.—The **Olfactory Nerve** may be involved in fractures extending across the cribriform plate of the ethmoid, or in severe cases of contusion of the anterior lobes of the brain without fracture, resulting in loss of smell (anosmia).

The **Optic Nerve** is sometimes ruptured in fractures of the base of the skull running into the optic foramen, leading to sudden irremediable blindness; or it may be compressed by effused blood or inflammatory exudation, either within or outside of its sheath, causing more or less complete loss of vision preceded by optic neuritis (*i.e.*, inflammation of the intra-ocular termination of the nerve, or papillitis); but if the hæmorrhage has not been very extensive, vision may be in measure restored. Orbital cellulitis not unfrequently causes pressure on the nerve, either immediately as a result of the inflammation, or subsequently by cicatricial contraction. Syphilitic disease of the sheath, or the formation of a gumma in its neighbourhood, or intra-orbital aneurisms or tumours, may likewise induce amblyopia from pressure on the trunk.

The **Third Nerve** (*motor oculi*) being entirely motor, paralytic symptoms are those to be looked for. They may arise from *central* causes, such as syphilitic or degenerative changes in the floor of the third ventricle; or from *peripheral* lesions, such as aneurisms, tumours, trauma, etc., either in the orbit, sphenoidal fissure, or base of the skull. The **Symptoms** of complete paralysis are as follows: (*a*) Ptosis,

or drooping of the upper eyelid, from loss of power in the levator palpebræ superioris; (*b*) external strabismus, or squint, from paralysis of the inner, upper, or lower recti, the eye being also directed a little downwards from paralysis of the inferior oblique; (*c*) mydriasis, or dilatation of the pupil, from palsy of the iris; (*d*) loss of accommodation, from the ciliary muscle being paralyzed; and (*e*) some slight protrusion of the eyeball (exophthalmos), owing to most of its muscles being flaccid and relaxed. In consequence, however, of its close proximity to the fourth, fifth, and sixth nerves in the walls of the cavernous sinus and sphenoidal fissure, symptoms referable to these trunks are often associated with the above, as also venous congestion of the eye and orbit from pressure on the sinus. Should the eyeball be totally immobilized from paralysis of all its muscles without venous congestion, the condition is known as ophthalmoplegia externa, and is always due to central disease affecting the floor of the third ventricle, and probably of syphilitic or tabetic origin. The **Treatment** in most cases consists in the administration of mercury and iodide of potassium.

Paralysis of the **Fourth Nerve** (*Pathetic*), which supplies the superior oblique muscle, results in defective movement of the eyeball downwards and outwards.

The **Fifth or Trigeminal Nerve** is occasionally torn in head injuries, giving rise to anæsthesia, with perhaps ulceration of the cornea; but such cases are exceedingly rare. Much more common is the disease known as *trigeminal neuralgia*, or tic douloureux, which is more frequently observed in women than in men. It is to be clearly distinguished from the simpler forms of neuralgia due to some local irritation or general weakness by the paroxysmal character and violence of the pain: hence the term 'epileptiform tic' has been applied to it, and not inaptly represents the terrible nature of the affection. As a rule, it commences in the infra-orbital or inferior dental branches, radiating thence to all the other divisions of the nerve. The paroxysms are not very frequent at first, but they rapidly increase both in number and severity, until at last the patient becomes utterly prostrate, and either becomes a morphia habitué, or may even attempt suicide. The condition is often influenced considerably by the general health, and intermissions of varying length occur. The attacks are accompanied by twitching of the muscles of the face, and even of the neck; also by unilateral sweating and hyperæmia of the head, and the development of such marked 'points douloureux,' that possibly the patient cannot brush his hair or wash his face on the affected side, which becomes dirty and is often shiny from trophic changes. Lachrymation is a marked feature during the attacks, and there may be a considerable increase in the salivary secretion, as also in that of nasal mucus.

The **Cause** of the neuralgia is unknown; in a few cases tumours of an endotheliomatous character have been found involving the ganglion, but in the great majority nothing abnormal can be found either in the ganglion or its branches.

In the **Treatment** of epileptiform tic innumerable remedies have

been used, but the relief, if any, has been transient. Morphia is the only agent which can be relied on, and the large and increasing doses required do so much physical and mental harm as to render its use quite unjustifiable, except as a temporary expedient. Of course, all sources of reflex irritation should be relieved or treated, such as carious teeth, errors of refraction, intranasal trouble, ovaritis, etc. If the pain persists, **Operative Measures** will sooner or later be required. Neurotomy and nerve-stretching can only give temporary relief, and excision even of large portions of the nerve-trunks is very frequently followed by recurrence. The only procedure that holds out any certain hope of cure is removal of the Gasserian ganglion, or, at any rate, of its lower half; the facts that the first division of the nerve is rarely involved in trigeminal tic, that the nutrition of the eyeball is largely dependent on the maintenance of its nerve-supply, and that the upper part of the ganglion is intimately adherent to the outer wall of the cavernous sinus, have determined the practice of leaving the ophthalmic portion of the ganglion intact in the majority of cases. The results of this operation have been very gratifying, and have improved with increased practice and modern methods. At the same time it must not be looked on as devoid of operative dangers or risks; and hence, if the neuralgia is definitely limited to one division only, an extracranial neurectomy of an extensive character is advisable before attacking the ganglion; recurrence after such an operation, or the primary involvement of two divisions, indicates the major operation.

The *Supra-orbital Nerve* does not very commonly require division or extraction, since neuralgia of this trunk is usually distinct from epileptiform tic, and certainly more amenable to therapeutic measures. The pain often recurs about the same time each day, and may be treated by giving a pill containing ferri sulph., 1 grain, quininæ disulph., 2 grains, and morphinæ hydrochlor., $\frac{1}{12}$ grain, four hours before the attack is expected, and repeating it every hour till six pills in all have been taken. At the same time attention must be directed to any local cause of irritation. Should the pain persist in spite of treatment, neurectomy may be undertaken. The nerve emerges from the orbit through the supra-orbital notch, lying at the junction of the inner and middle thirds of the upper margin; it is reached by an incision following the course of the eyebrow, through which the orbicularis is divided along the line of its fibres (Fig. 105, *a*). By incising the periosteum and depressing it, together with the orbital fat, the nerve can be followed back for some distance, and a considerable portion removed.

The *Infra-orbital Nerve* emerges from the foramen of the same name at a spot about $\frac{1}{2}$ inch below the centre of the lower margin of the orbit. It can be reached and divided by a horizontal or curved incision placed over this site (Fig. 105, *c*); but since such an operation is unlikely to give more than temporary relief, *the root of the second division* should be at once attacked if operative procedures are necessary. It is most desirable to divide the nerve behind Meckel's ganglion, and hence the operations which are performed from the face (either Wagner's, which follows the floor of the orbit, or Carnochan's, which traverses the antrum) are objectionable, whilst they are almost certain to leave ugly cicatrices (Fig. 105, *d*).

The *pterygoid* method, or, as it is called, the Braun-Lossen operation, is without doubt the best for dealing with the root of the second division. Our experience of this proceeding, which is now extensive, has induced us to modify the original plans considerably, and our usual method of procedure is as follows: The incision commences at the external angular process of the frontal bone, follows

the upper border of the zygoma, and curves downwards in front of the ear to reach the angle of the lower jaw (Fig. 90, B). The flap thus marked out, consisting only of skin and subcutaneous fat, is dissected forwards, temporarily fixed by a suture to the nose, and protected with gauze. The zygoma is exposed by a horizontal incision through the periosteum, which is cleared from the bone by a suitable raspatory, and drilled front and back so as to carry silver wires in the subsequent suturing up (Fig. 106); it is then sawn through and turned down, together with the masseter. The mouth is slightly opened with a gag, and the temporal tendon pulled well backwards from the front of the temporal fossa by retractors, exposing thereby the pterygo-maxillary fissure, although the coronoid process is sometimes so large as to need partial or complete removal. The internal maxillary vessels are then looked for, and, if possible, secured by liga-

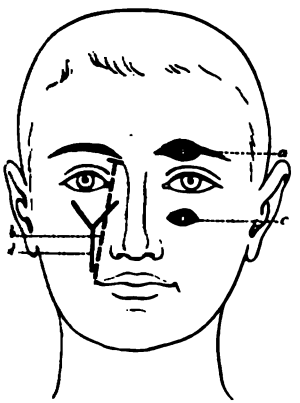


FIG. 105.—*a*, Incision for division of supra-orbital nerve; *b*, line indicating position of supra-trochlear nerve, passing from angle of mouth through the inner canthus; the short cross-line at its upper end is the incision required to expose it; *c*, position of infra-orbital nerve and incision; *d*, Carnochan's incision for neurectomy of the second division.

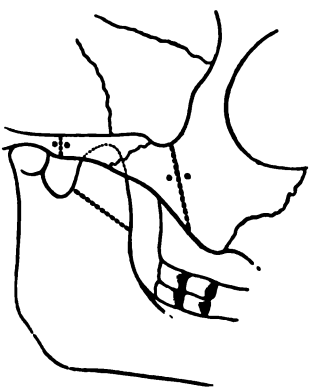


FIG. 106.—ZYGOMA AND LOWER JAW IN SITU TO SHOW POSITION OF SAW-CUTS AND DRILL-HOLES IN THE BRAUN-LOSSEN OPERATION, AND IN THAT FOR REMOVAL OF THE GASSERIAN GANGLION.

tures and divided. The root of the second divison of the fifth nerve can then be hooked up on an aneurism needle as it emerges from the foramen rotundum, and divided- a proceeding much facilitated by chiselling away a bony prominence which rises from the base of the great wing of the sphenoid, on the posterior aspect of the junction of the two limbs of the pterygo-maxillary fissure. By also dividing the nerve as it emerges from the infra-orbital foramen through an incision in the face, the whole trunk is set free, and can be removed by traction, all the dental branches being torn across. The displaced structures are then put back in position, the zygoma is sutured with silver wire, and the incision in the skin closed. The results gained by this method have been very satisfactory, the scar being scarcely evident, and the movement of the jaw not impaired.

In the *third division* trigeminal tic usually affects the lingual and inferior dental branches, and should be dealt with by dividing the trunk of the third division at the foramen ovale.

The *Inferior Dental Nerve* is sometimes, however, the seat of neuralgia, due

to compression in its bony canal as a result of dental troubles. It may then suffice to trephine the inferior maxilla, making the necessary incision along its lower border, and remove half its thickness, so as to expose the nerve in its canal.

Section of the third division of the fifth nerve at the foramen ovale is best accomplished in the following manner: A flap of skin and subcutaneous tissue is reflected forwards from the parotid region, extending from the zygoma above to the angle of the jaw below (Fig. 90, B), exposing thus the parotid gland with the socia parotidis and the masseter muscle, covered by fascia. If the incision is kept strictly to the subcutaneous tissues, the facial nerve is in no way endangered. The masseter is then divided transversely immediately below the socia parotidis, and the vertical ramus of the inferior maxilla cleared of muscle and periosteum to a sufficient extent to allow the application of a ¾-inch trephine just below the sigmoid notch, the remaining bridge of bone being subsequently removed by cutting pliers; enough bone is left in front and behind to preserve the continuity of the jaw with the articular and coronoid processes. The fibres of the external pterygoid muscle can now be seen crossing the upper part of the wound horizontally, and over it the internal maxillary artery sometimes courses, giving rise to considerable hæmorrhage if it is wounded. The lingual and dental nerves are usually found close together, emerging from under the outer pterygoid muscle, and lying between the internal pterygoid and the bone. The peripheral portions should be twisted or pulled up, and divided below as far down as possible, whilst by retracting the external pterygoid outwards, the foramen ovale can be seen, if electric illumination is employed, and the nerve-trunks divided at the point of exit. The wound usually heals well, and leaves but little scar, although some impairment in the mobility of the jaw may result from the cicatrization following disturbance of the muscles and tissues.

Removal of the Gasserian ganglion is now usually undertaken through the temporal region by some modification of what is known as the Hartley-Krause method. The pterygoid route originally followed in the pioneer operations by one of us (W. Rose) must be acknowledged to give insufficient exposure to ensure removal of the ganglion, and is now merely of historical interest.

The *Hartley-Krause operation* was devised independently by the two surgeons whose names are associated with it. An Ω-shaped flap is marked out in the temporal region, the base situated just above the zygoma. Through this the subjacent bone is divided by chisel or electric saw, and the whole flap of skin, muscle, and bone is turned down *en bloc*, exposing the dura mater, which is gently stripped up from the middle fossa of the skull as far as the cavernous sinus. The middle meningeal artery is exposed and tied just above the foramen spinosum, or the foramen may be plugged with purified sponge or wax. Hæmorrhage from the small vessels, especially the veins, of the dura mater is sometimes profuse, but usually ceases upon gentle pressure. The dura mater and temporo-sphenoidal lobe of the brain are held up by one or two suitably-shaped spatulæ, and the second and third divisions of the nerve are seen running from their foramina to the ganglion. The dural sheath of the ganglion (cavum Meckelii) is opened, the ganglion itself detached from the bone, and as much of it as is thought necessary removed. The cavernous sinus may be wounded in this stage, or the dura itself give way and cerebro-spinal fluid escape. Removal of the spatulæ allows the brain to re-expand; the bone is then replaced, and the wound closed. The temporary compression of the brain seems to do no harm if the spatulæ are held with great gentleness, although temporary aphasic symptoms have been known to follow.

Various modifications of this procedure have been suggested. Many surgeons remove the bone from the temporal fossa completely with trephine and rongeur, and this certainly gives a better approach to the deeper parts. The subsequent defect in the cranium is covered in by the temporal muscle, and is of little importance. As to the extent of bone that is removed, practice varies. Some keep well above the infra-temporal crest and work rather from above—*i.e.*, they simply take away the portion of bone turned down in the original Hartley-Krause method; others, notably Doyen,* take away the bone from the floor of the middle fossa

* For Doyen's operation, see *Practitioner*, May, 1902.

down to the foramen ovale; others, again, divide the zygoma at each end of the oval flap of skin and muscle turned down, and thereby gain a certain amount of room. Such modifications are of little real importance compared with the recognition of the principle that the ganglion can only be satisfactorily approached by lifting up the temporo-sphenoidal lobe and dura mater.

In all these operations special care must be taken of the eye, as its nutrition is likely to suffer. The conjunctival sac should be washed out with warm sublimate solution (1 in 2,000), and the lids stitched together. These stitches are removed on the fourth or fifth day, and the conjunctiva washed with warm boracic lotion, but a pad should be kept over the eye for a fortnight.

The **Sixth Nerve** may be torn or compressed, either in its intracranial course along the inner wall of the cavernous sinus, or as it passes through the sphenoidal fissure, or in the orbit, as a result of penetrating wounds or blows. Its division causes paralysis of the external rectus and consequent internal strabismus.

The **Seventh or Facial Nerve** may be *paralyzed* from a great variety of causes, which may be described under the following headings:

(a) *Intracranial Lesions.*—If simply *cortical*, as from pressure, hæmorrhage, degeneration, etc., a limited portion of the opposite side of the face is usually involved. If *subcortical*, or in the corona radiata or corpus striatum, as from hæmorrhage, or softening due to carotid thrombosis or embolus, the paralysis appears on the opposite side together with hemiplegia, but only the lower half of the face is palsied, the associated movements of the eyelids being left. If the lesion is situated in the *pons*, the deep facial centres may be implicated, and then paralysis with rapid atrophy of the facial muscles ensues on the same side as the lesion, together with loss of power of the opposite arm and leg (crossed paralysis). If the *root* of the nerve between the centres and the internal auditory meatus is involved, the whole of the same side of the face is paralyzed, accompanied, as a rule, by deafness.

(b) *Cranial Lesions.*—There are two not uncommon causes grouped under this heading, viz., (i.) fracture of the base of the skull, involving the petrous portion of the temporal bone, the paralysis supervening either immediately after the injury from laceration, a rare phenomenon, or some weeks later from implication in the callus, the usual cause; or (ii.) as a complication of chronic otorrhœa, and then due to compression or inflammation of the nerve in the aqueductus Fallopii. In both these forms the palsy is complete on the side affected, and owing to the communication of the facial with the petrosal nerves in this part of its course there may be unilateral drooping of the velum palati, the uvula being deflected towards the sound side.

(c) *Extracranial lesions* from injury, inflammation from exposure to cold, or the pressure of a tumour, *e.g.*, malignant disease of the parotid. This variety has been called 'Bell's palsy,' and is usually characterized by the whole side of the face being affected, but without implication of the palate or uvula.

The general **Signs** of facial paralysis (Fig. 107) are as follows: The side of the face is immobile and expressionless, all the natural folds and wrinkles being lost; the eye cannot be completely closed, and on attempting to do so the eyeball is usually seen to roll upwards and

outwards; ulceration, and even perforation, of the cornea m from this exposure. From the drooping and relaxation of t eyelid, the apposition of the punctum lachrymale to the co is imperfect, and thus tears escape over the face (epiphora), a aggravated by the loss of the suction-like action of the lachr owing to the associated paralysis of the tendo oculi and ten On attempting to move the face, as in laughing or showing t the muscles on the non-paralyzed side are alone contracted, an asymmetry results from the drawing over of the opposite si lips cannot be closed firmly, and hence whistling and such-lik are prevented. Food collects between the cheek and the tee

FIG. 107. FACIAL PARALYSIS. (FROM PHOTOGRAPHS.)

On the left side the face is in a position of rest; on the right side an at been made to close the eyes, that on the paralyzed side remaining the eyeball rolling upwards and outwards, whilst the asymmetry o becomes more manifest.

to paralysis of the buccinator, and the patient after a meal has out the débris with a spoon or his fingers.

The **Treatment** of facial paralysis necessarily depends upon it In the majority of cases medical treatment (including the adm tion of perchloride of mercury and iodide of potassium) will together with massage and electricity; in others, surgical m with a view to remove some obvious cause of pressure may b sary. Where, however, the paralysis cannot be dealt with way, *nerve anastomosis* may be undertaken, the whole or a pc the spinal accessory nerve being united to the divided periph of the facial nerve. The results hitherto obtained in a few cas been encouraging; facial movements slowly returned, but at fi

always elicited by and accompanied with movements of the shoulder; in time, however, they became more independent, but were rarely quite free. However, the operation gave a certain amount of muscular play, and removed the facial asymmetry so characteristic of this lesion.

Facial Tic (or histrionic spasm) consists of a clonic contraction of the facial muscles, due to some lesion of the centre in the pons or cortex. The condition causes great discomfort to the patient, and may involve the whole side of the face, or merely one part of it, such as the orbicularis oculi. **Treatment** consists in the administration of nerve tonics or antispasmodics, and, failing that, *stretching*, or even in severe cases division, of the *facial nerve* has been employed, but is most unsatisfactory.

Operation.—The facial nerve is exposed immediately below the ear, its position being indicated by a horizontal line drawn from the middle of the anterior border of the mastoid process, and usually corresponding to the point where the mastoid meets the lobule of the ear. The incision extends from just behind the external meatus along the anterior border of the sterno-mastoid muscle to the level of the angle of the jaw. The parotid gland is separated from the muscle, and both are well retracted, exposing by this means the posterior belly of the digastric. The facial nerve is found above this, running directly forwards from the centre of the mastoid process. The great auricular nerve is divided in the superficial incision, and the posterior auricular vessels will require a ligature. The internal jugular vein is close to the posterior margin of the wound. The operation is a deep one, and by no means easy in a patient with a thick neck. The *effect* of stretching the nerve is to paralyze it temporarily, but the ultimate results have been by no means encouraging, only one case out of twenty collected by Godlee being successful.

The Auditory Nerve may be injured in fractures of the base of the skull, either one or both sides being involved. Incurable deafness usually results, often associated with facial palsy.

It is a little doubtful what effect would be produced by injury of the **Glosso-pharyngeal Nerve**, but in one case in which it was supposed to be compressed the patient suffered from difficulty in swallowing and speaking, together with persistent ulceration of the tongue; death resulted from œdema of the glottis.

A severe injury to the **Pneumogastric Nerve** may prove rapidly fatal, but less serious lesions result in palpitation, vomiting, and a sense of suffocation; such phenomena sometimes manifest themselves after head injuries, especially fractures involving the posterior fossa, and indicate that the jugular foramen has been encroached on. The nerve is also exposed to injury in operations about the neck, *e.g.*, ligature of the carotid, or removal of tuberculous glands. Irritation causes vomiting and temporary inhibition of the heart's action; one-sided division sometimes does comparatively little harm, but if both nerves are divided, death results from laryngeal paralysis or from such complications as œdema or congestion of the lungs. When the vagus is injured in the lower part of the neck or compressed by an aneurism, or if the recurrent laryngeal nerve is divided or compressed, hoarseness or partial aphonia is produced, from paralysis either of all the muscles on one side of the larynx, or in slighter cases only of the abductor (crico-arytenoideus posticus).

The **Spinal Accessory Nerve** may be irritated, either at its exit from

the skull by a fracture running through the jugular foramen, or in its peripheral course by inflamed lymphatic glands, etc. It is not unfrequently divided in operations for the removal of tuberculous glands, and may cause some temporary drooping of the shoulder. Clonic spasm of the sterno-mastoid and trapezius is generally due to central changes, and it is for this form of spasmodic torticollis that *stretching or division of the spinal accessory nerve* is employed.

Operation.—The nerve runs downwards and backwards at right angles to the centre of a line passing from the angle of the jaw to the apex of the mastoid process; it enters the deep aspect of the sterno-mastoid about 3 inches below that spot. An incision is made along the anterior border of the sterno-mastoid, reaching from the ear to the cornu of the hyoid bone. The fascia is divided, and the muscle drawn backwards to expose the posterior belly of the digastric, from under the lower border of which the nerve emerges, passing first in front and then below the transverse process of the atlas, which can be readily felt. The operation has not given good results, since, even if the twitching of the head and neck ceases, the spasmodic phenomena often recur elsewhere.

The **Hypoglossal Nerve** may be accidentally divided in an operation, or compressed by an aneurism of the external carotid, or by a new growth. Unilateral paralysis or weakness of the tongue results, the organ, when protruded, being directed towards the paralyzed side.

The Spinal Nerves.

The nerves constituting the **Cervical Plexus** are exposed to injury either from blows, dislocations of the cervical spine, penetrating wounds, or during operations. No very serious results follow, except in the case of the **Phrenic Nerve**, division of which may cause instant death by paralysis of the diaphragm, although when but one nerve is divided the patient can survive. Irritation of the nerve gives rise to spasmodic cough or hiccough.

The **Brachial Plexus** may be injured from exactly similar causes, paralysis or spasm of the muscles of the arm arising from division or irritation of the motor branches, whilst neuralgia, hyperæsthesia or anæsthesia, may follow from damage to the sensory trunks. Thus a blow on the back of the neck opposite the fifth or sixth vertebræ caused paralysis of the serratus magnus and rhomboids (winged scapula); an old unreduced unilateral dislocation of the seventh cervical vertebra produced intense neuralgia along the course of the ulnar nerve, and many similar instances might be mentioned.

One special form of injury may be alluded to in which the roots of the fifth and to a less extent of the sixth cervical nerves are wrenched or torn as a result of a fall on the shoulder, which is pressed downwards, whilst the head is forced over to the opposite side, a type of accident which is liable to follow a spill from a high dog-cart. The result is paralysis of Erb's pre-axial group of muscles, including the supraspinatus, infraspinatus, biceps, deltoid, and supinators, arising from the fifth nerve, whilst the extensors of the fingers and wrist are involved when the sixth nerve is also injured. Sensory lesions are usually slight, and recovery, though slow, ensues after a time. A

similar affection sometimes appears in infants as a birth paralysis (Duchenne), due to excessive lateral displacement of the head during delivery. The shoulder engages the brim of the pelvis, and is hindered in its onward passage, whilst the head is forced on.

The **Treatment** is mainly symptomatic, including the administration of iodide of potassium and the local application of blisters or other counter-irritants and of electricity. In cases where there is severe and intractable neuralgia, not referred to any discoverable lesion, or where clonic spasm of the muscles of the arm and shoulder are met with, ***stretching of the brachial plexus*** may be required. In several cases of Duchenne's birth paralysis operation has been undertaken to expose the injured fifth and sixth nerves; the cicatrix has been found and removed, and a good result has followed.

Operation.—The patient lies on his back, with the head directed to the opposite side, and the arm well drawn down; a cushion is inserted under the shoulder to steady it. An incision is made above the centre of the clavicle, 3 or 4 inches in length, parallel to the anterior border of the trapezius. The platysma and deep fascia are divided, and the deep cellular tissue opened up by retracting the margins of the wound. The posterior belly of the omo-hyoid is thus exposed, and the posterior border of the scalenus anticus defined. The cords of the plexus are found emerging between the latter muscle and the medius; they are carefully isolated by division of the sheath covering them, and pulled upon by the finger or an aneurism needle passed under them. Special care must be taken of the lowest cord of the plexus, which passes behind the subclavian artery. The nerves are stretched both centripetally and centrifugally. Excellent results have followed this operation, although in a few cases the necessary cicatrization which followed led to a recurrence of the symptoms.

The **Circumflex Nerve** is liable to injury from its exposed position, winding round the outer side of the neck of the humerus about a finger's breadth above the middle of the deltoid. Blows upon the shoulder may in this way cause paralysis; it is sometimes torn or compressed in fractures of the surgical neck of the humerus, or in dislocation of the shoulder, or it may be impacted in the callus arising from the former injury. Paralysis of the deltoid and teres minor follows, evidenced by inability to raise the arm from the side, whilst the wasting of the former muscle causes undue prominence of the acromion. There may be temporary anæsthesia over the posterior fold of the axilla, but this does not last long. No operative treatment has been adopted, although we see no reason why it should not be attempted in suitable cases.

The **Musculo-Spiral Nerve** is not unfrequently damaged in fractures and dislocations of the upper extremity of the humerus, but is especially exposed to injury in the musculo-spiral groove, where it lies close to the bone. It is implicated with or without other nerves in crutch palsy, or by lying asleep with the arm across the edge of a chair or table, as so frequently occurs in drunken people (commonly called 'Saturday-night paralysis'). It is not unknown after operations when the outstretched arm has rested on the edge of the table, and is a disconcerting sequela that is easily preventable. It has also occurred after operations in the Trendelenburg position, where the arms have

been kept above the patient's head, the upper end of the humerus pressing against the brachial plexus, and causing symptoms not purely musculo-spiral in type. In this position the arms should not be elevated, but folded across the chest.

The **Symptoms** arising from its total division are as follows:

A. Anæsthesia over the front and back of the outer side of the elbow and fore-arm (external cutaneous branches), over the radial side of the dorsal aspect of the wrist and hand, and over the back of the thumb, index, middle, and half of the ring fingers, to a variable extent (Fig. 110, *ra*).

B. Paralysis of the following groups of muscles:

(i.) Of the extensor of the fore-arm (triceps); hence the fore-arm can only be extended by its own weight.

(ii.) Of the long and short supinators; hence the hand is pronated, the only supinator remaining being the biceps.

FIG. 108.—WRIST-DROP FROM PARALYSIS OF THE MUSCULO-SPIRAL NERVE. (TILLMANNS.)

(iii.) Of the radial and ulnar extensors of the wrist; hence wrist-drop (Fig. 108), a condition also present in certain lesions of toxic or central origin, *e.g.*, lead palsy and progressive muscular atrophy.

(iv.) Of the extensors of the fingers and thumb, which either hang limp and motionless, or may be bent up into the palm from the unopposed action of the flexor muscles. If, however, the wrist and proximal phalanges are supported and extended, the terminal phalanges can be straightened by the action of the interossei and lumbricales.

Treatment consists in massage and electricity applied to the muscles, but in some cases an operation is necessary.

Operation.—The nerve can be exposed on the outer side of the arm after it has traversed the external intermuscular septum, where it lies between the brachialis anticus and supinator longus. To define this intersection the fore-arm is semi-flexed and pronated, and an incision made extending from the centre of the crease of the elbow upwards and outwards along a line made by prolonging upwards the radial border of the fore-arm, which in this position corresponds with the supinator longus muscle. The interspace is opened up, and the nerve found together with the termination of the superior profunda artery. From this point the nerve may be traced upwards, if necessary, by dividing the intermuscular septum, and retracting or dividing the triceps.

To expose the upper part of the nerve as it enters the groove, the arm is placed over the body, and the posterior border of the deltoid defined. An oblique incision is made a finger's breadth behind this, and the intersection between the long and outer heads of the triceps found. By opening up this space the finger can be passed down to the bone, and the nerve, together with the superior profunda artery, readily exposed.

Where the nerve is impacted in the callus arising from a fracture of the middle of the shaft of the humerus, it is often best to expose it by a median incision down the back of the arm, splitting the triceps, the centre of the wound being opposite the insertion of the deltoid.

The **Median Nerve** may be damaged in fractures and dislocations of the humerus, but is most frequently injured just above the wrist by glass wounds, due either to bursting of bottles, etc., or to thrusting

FIG. 109.

FIG. 110.

FIGS. 109 AND 110.—DISTRIBUTION OF SENSORY NERVES OF HAND FROM FRONT AND BACK.

m, Median nerve ; *u*, ulnar ; *ra*, radial.

the hand and arm through a window. *Paralysis* necessarily results in these cases, with the following symptoms :

If divided just above the wrist :

A. Anæsthesia over the palmar aspect of the radial side of the hand, over the front of the thumb, index, middle, and half the ring fingers, and over varying portions of the dorsum of the same (Figs. 109 and 110).

B. (i.) Paralysis of the outer group of the short muscles of the thumb (*i.e.*, abductor, opponens, and outer half of the flexor brevis pollicis), so that the thenar eminence wastes.

and the movement of 'opposition' is impaired, the thumb remaining extended by the side of the fingers (Duchenne's 'ape-hand').

(ii.) Paralysis of the outer two lumbrical muscles, causing loss of power of flexion at the metacarpo-phalangeal joints of the index and middle fingers.

The great impairment of mobility in the hand and fingers so often seen in these cases depends not so much on paralysis of muscles as on the fact that in the majority of them the synovial sheaths of the wrist are also laid open and involved in septic inflammation, which leads to the formation of diffuse adhesions. Hence the prognosis is often unsatisfactory, even when the nerve has been skilfully sutured at a secondary operation.

If divided at the bend of the elbow or in the arm, to the above-described symptoms are added:

(i.) Loss of pronation from paralysis of the two pronators.

(ii.) Paralysis of the flexor carpi radialis, causing defective wrist flexion on the radial side and impaired radial abduction.

(iii.) Paralysis of the flexor longus pollicis, of the flexor sublimis, and the outer half of the flexor profundus digitorum, leading to loss of power in the hand-grasp, especially on the radial side, and perhaps hyper-extension of the wrist.

(iv.) Paralysis of the palmaris longus.

Operations.—When the nerve has been divided, primary or secondary nerve suture should always be undertaken. In the latter case incisions are made through the old scars, which may be removed with advantage, the ends of the nerve clearly defined, and the bulb removed. Suture is often very difficult from lack of material, and to assist in the apposition of the segments the hand is flexed to a right angle, and also the elbow, and maintained in that position by a poroplastic or plaster of Paris splint.

In order to stretch the nerve, it may be exposed in the arm by an incision similar to that for ligature of the brachial artery, or at the wrist by an incision placed to the ulnar side of the flexor carpi radialis tendon, between that structure and the palmaris longus or flexor sublimis tendons.

The **Ulnar Nerve** is exposed to injury at the wrist, as also in the hollow between the olecranon and the inner condyle of the humerus, and paralysis may be caused by wounds, fractures, blows, implication in callus, etc. The symptoms are very characteristic.

If divided at the elbow:

A. Anæsthesia of the ulnar side of the front of the wrist and palm (palmar cutaneous branch), over the back of the hand, and of the little and half the ring fingers, back and front (Figs. 109 and 110).

B. (i.) Paralysis of the flexor carpi ulnaris, causing weakness in flexion and in ulnar adduction of the wrist.

(ii.) Paralysis of the inner half of the flexor profundus, with weakened hand-grasp, especially in the ring and little fingers.

(iii.) Paralysis of the two inner lumbricales and of all the interossei; hence, loss of adduction and abduction of the fingers, with flexion of the two last phalanges in each finger and

hyper-extension at the metacarpo-phalangeal joint (main-en-griffe or claw-hand, Fig. 111). The interosseous spaces also become very evident from atrophy of these muscles.

(iv.) Paralysis of the short muscles of the little finger, of the inner group of short thumb muscles (adductor transversus, adductor obliquus, and deep portion of flexor brevis), and of the palmaris brevis.

If divided just above the wrist, the anæsthesia only involves the palmar aspect of the hand and back of the terminal phalanges, whilst the paralysis merely affects the short palmar muscles. Additional impairment of movement may, however, arise from septic inflammation of the long tendons and their sheaths.

Treatment.—If divided, the nerve must be dealt with (according to the rules already given) at the injured spot.

To expose the nerve for the purpose of stretching for neuralgia, or suturing, the following methods may be adopted: (*a*) In the upper arm an incision is made similar to that for tying the brachial artery, but half an inch behind it. (*b*) At the elbow, cut down just behind the internal condyle, and find the nerve behind the internal intermuscular septum with the inferior profunda artery. (*c*) Just above the wrist it lies to the radial side of the flexor carpi ulnaris between the tendon and the ulnar vessels; the skin and deep fascia alone need division.

FIG. 111.—CLAW-HAND (MAIN-EN-GRIFFE) FROM ULNAR PARALYSIS. (AFTER BYROM BRAMWELL.)

The **Intercostal Nerves** are frequently the seat of severe neuralgia, either from a chronic neuritis, probably of toxic origin, from compression by tumours or inflammatory lesions of the ribs, or from injury or pressure directed to the nerve-roots as they emerge from the spine. Herpes zoster or shingles is a very frequent sequela to such pain, and may be followed by some amount of anæsthesia.

Sciatica, or neuralgia of the great sciatic nerve, is a most painful affection, and often exceedingly intractable. It may arise from the following **Causes**: (*a*) Inflammation of the neurilemma (acute or chronic), the result of cold, injury, gout, rheumatism, syphilis, and many toxic agents; (*b*) pressure upon the extrapelvic portion of the nerve, as by aneurisms, tumours, or old-standing dislocations of the head of the femur on the dorsum ilii; (*c*) similar pressure upon the nerve in the pelvis, or as it emerges through the sacro-sciatic notch, as from sarcoma or osteoma of the pelvic bones, rectal or uterine cancer, a pregnant uterus, or uterine fibroids; (*d*) pressure upon the nerve-roots in the spinal canal, as from caries or sarcoma; (*e*) chronic diseases of the spinal cord, such as tabes.

The **Symptoms** are very evident, the pain shooting down the back of the thigh and often referred to the toes. It is of a paroxysmal nature, and may be brought on by pressure over almost any part of the nerve or by movements of the thigh, and hence the patient's gait is stiff and shambling. Tenderness in the line of the nerve is felt when the cause is a peripheral neuritis, and the trunk may sometimes be detected on palpation as a thickened cord. The limb is often kept slightly bent, but complete flexion of the thigh on the pelvis is an impossibility; and if, when the patient is standing against a wall, the limb can be raised to a right angle with the knee extended, it is certain that sciatica is not present.

The **Treatment** necessarily varies with the cause. If due to neuritis or perineuritis, general anti-syphilitic or anti-rheumatic measures may be adopted, and blisters or sedative remedies in the more acute cases applied to the back of the thigh. Hypodermic injections of morphia and atropine may also be useful; but if all the usual anti-neuralgic remedies have been exhausted without benefit, stretching of the nerve may be employed.

Stretching of the sciatic nerve may be required for: (i.) neuralgia of an intractable type; (ii.) paralysis or spasm of muscles supplied by it, owing to adhesions contracted between it and surrounding parts, the result of injury, cellulitis, or perineuritis; (iii.) in paralysis or spasm due to some forms of tabes. The nerve may also be exposed in order to suture it after it has been divided. Nerve-stretching may be accomplished without operation by flexing the thigh upon the abdomen and then extending the knee; in cases of sciatica an anæsthetic will be required for this, but it may be attempted before undertaking further measures.

The nerve is best *exposed* for stretching at the point where it emerges from under cover of the gluteus maximus, midway between the tuber ischii and the great trochanter. The patient lies in the prone position with the limb slightly flexed, and a 4 or 5 inch incision is made vertically downwards from the gluteal fold in the middle line of the thigh. The lower border of the gluteus maximus is first exposed, and its fibres seen running downwards and outwards. The hamstring muscles emerging from under it are drawn inwards, and the nerve is found ensheathed in loose connective tissue; it is stretched, by a finger hooked under it, both peripherally and proximally.

The **Anterior Crural Nerve** may be paralyzed as a result of injury or pressure, and may be the seat of neuralgia or spasm. Its division causes paralysis of the quadriceps extensor, pectineus, and sartorius, and the most marked effect will be secondary flexion of the knee-joint from the unopposed action of the hamstrings; anæsthesia extends over the front of the thigh and along the inner side of the leg and foot as far as the ball of the great toe. The nerve may be exposed on the outer side of the femoral vessels, just below Poupart's ligament, by a vertical incision half an inch outside the line of the artery.

The **External Popliteal Nerve** may be divided during a subcutaneous tenotomy of the biceps, to which it lies immediately internal; or compressed, as it winds round the neck of the fibula, by strapping,

bandages, or splints; or it may be injured in fractures of the neck of the fibula. Total division causes anæsthesia over the dorsum of the foot, together with paralysis of the extensor and peroneal groups of muscles; and from the contraction of the unbalanced opposing groups, the paralytic form of talipes equino-varus results. The nerve may be exposed by making an incision 1½ inches long to the inner side of the biceps tendon, terminating at the neck of the fibula. The knee is then flexed, and the nerve is readily found embedded in the loose cellular tissue of the popliteal space.

The **Internal Popliteal Nerve** is much less exposed to injury owing to its more sheltered position. Division results in anæsthesia of the back of the calf and sole of the foot, and in paralysis of the calf muscles, flexors of the foot and toes, and of the short muscles of the sole. Paralytic talipes calcaneo-valgus is very likely to ensue. The nerve is laid bare by a vertical incision in the middle of the popliteal space, which should avoid the short saphena vein. After division of the deep fascia, the nerve is the most superficial structure.

If the **Tibial Nerves** are divided, the resulting effects are more limited; thus, paralysis of the extensors of the foot and paralytic talipes equinus result from division of the anterior tibial; and paralysis of the short and long flexors of the foot and of the interossei, with resulting talipes calcaneo-valgus, follow lesions of the posterior tibial. The nerves may be exposed in the same way as the accompanying arteries (p. 340).

The **Sympathetic Nerve-trunk** in the neck is occasionally compressed by aneurisms or tumours. If merely irritated, dilatation of the pupil on the same side and unilateral sweating of the head and face are produced; but, if divided, the pupil is contracted from unbalanced action of the third nerve. It has also been completely excised on both sides in the treatment of Graves' disease, and the operation appears to be of some value.

CHAPTER XVI.

SURGICAL DISEASES OF THE SKIN AND OF THE CUTANEOUS APPENDAGES.

A **Boil** or **Furuncle** is a limited form of infective gangrene involvi merely a small portion of skin and subcutaneous tissue, usually ro a hair follicle. Experimentally, a plentiful crop of boils can be p duced by rubbing a culture of staphylococci into the skin, and cl cally it is supposed that a similar infection through the hair follic is the most common cause of this condition. The secondary b around a primary one are without doubt due to the friction upon healthy integument of dressings, covered with pus and microbes.

People with a coarse skin and a tendency to comedones are speci liable to the occurrence of boils. A gangrenous inflammation en after infection, resulting in the death of the hair follicle, or of sweat or sebaceous gland involved, and of the surrounding connect tissue, and the slough thus formed is cast off by a process of suppu tion. A matured or ripe boil, therefore, consists of a central slo or core, a zone of pus around it, and external to this granulation ti merging into healthy skin and connective tissue. Although infect from without is the local exciting cause, some depression of the v powers is frequently present, which may lead to recurrence.

Signs.—A boil commences as a small red irritable pimple, f which a hair may often be seen to protrude, which increases gradu in size, becoming more and more painful, until it forms a co tumour, deep red in colour and exquisitely tender. A small whi spot appears in the centre, and around this so-called core yellow can be seen. Finally it bursts, discharging the pus, and subsequ the core or slough comes away. The process is then at an end, the wound rapidly heals by granulation. Occasionally the inflam tion extends more deeply into the subcutaneous tissues, constitu a 'carbuncular boil.' Lymphangitis sometimes follows, and neighbouring lymphatic glands may become sympathetically enla and painful, but rarely suppurate. A boil sometimes subsides wit suppuration, leaving the parts thickened and infiltrated, the condi then being known as a 'blind boil.'

Treatment.—Many boils may be left to burst naturally, tho possibly the process may be checked by surrounding them wi piece of ordinary adhesive plaster, with a hole over the apex of

swelling. Poultices are generally applied, and the boil is incised when mature. The pus should be received on portions of wool soaked in carbolic lotion (1 in 20), and the cavity lightly swabbed out with pure carbolic acid. A small collodion dressing is then applied. Constitutionally, tonics, such as iron and quinine, are usually required, except in plethoric individuals, in whom a spare diet and abstinence from stimulants may be recommended. A change of air to a bracing seaside place is often advisable, especially when a succession of boils has appeared.

A **Carbuncle** is a more extensive infective gangrene of the subcutaneous tissues, due to a local invasion with pyogenic microbes, the commonest being the *Staphylococcus pyogenes aureus*. It occurs in individuals run down by any general debilitating condition, such as albuminuria or diabetes, in whom the germicidal powers of the tissues are much depreciated; it is also occasionally met with as a sequela of acute fevers. The exciting cause may be some blow or squeeze, resulting in extravasation of blood or some local diminution of vitality; into this area cocci are implanted either by auto-infection, or more usually through the sweat-glands or hair follicles, or through some slight superficial abrasion.

Signs.—A carbuncle commences as a hard, painful infiltration of the subcutaneous tissues, the skin over which becomes red and dusky. The swelling gradually increases in size in all directions, until even a diameter of 6 or more inches is reached. As it extends peripherally, the central parts, which were formerly brawny, become soft and boggy, and the overlying skin shows evidences of yielding to the pressure within. Vesicles form on the surface, and finally pustules; these in turn burst, and allow a tardy exit to the ashy-gray sloughs and purulent discharge accumulated below. Fresh openings gradually develop, leading to a cribriform condition of the cutis, due probably to the passage of the pus along the lines of least resistance, viz., the perforations of the cutis at the sites of the sebaceous glands and hair follicles. Some of these apertures enlarge and run into one another, producing a central irregular crateriform opening, at the bottom of which lies the necrotic tissue. As the violence of the inflammation subsides, the sloughs gradually separate, leaving a clean granulating wound. Carbuncles most frequently occur on the back, the nape of the neck, the shoulders, and nates, where the vitality of the tissues is never very active; when they form on more vascular parts, such as the face and lips, the consequences may be even more serious, since infective thrombosis of the large veins may follow, and this may quickly spread up to the cavernous sinus. The soft and spongy tissue of the cheek is a very favourable place for the extension of the necrotic process, and there may be a wide area of mischief under an apparently insignificant superficial lesion. A carbuncle is usually single, and may be accompanied by lymphangitis and a painful enlargement of the nearest lymphatic glands.

There is often considerable constitutional disturbance of an

asthenic type, although the temperature is not necessarily m raised. Sometimes the gravest symptoms of blood-poiso (pyæmia or septicæmia) may supervene.

Diagnosis.—1. *From Boils.—Pathologically*, a boil is an infec gangrene of a small portion of the skin. A carbuncle affects subcutaneous tissues primarily, and the skin secondarily. *Clinic* boils are multiple, conical in shape, more localized, and when sup ration has occurred the process is terminated by the discharge of pus and slough through a single opening. Carbuncles, on the o hand, are usually single, much larger, flatter, and the sloug process may continue peripherally, whilst the central part is charging its sloughs through several openings. 2. *From Gumma* Cutaneous gummata are frequently multiple, occurring in pati with a distinct syphilitic history. They are not very painful, an not as a rule attain any great size. They usually ulcerate e leaving circular sores, or if multiple and confluent, sores with piginous outlines; there is generally but little definite slough The deeper gummata are also less painful, have but one opening, leave excavated sores, in the bases of which are yellowish slo like wet wash-leather. The discharge is not distinctly purulent, more like blood-stained gum, unless the sore becomes septic.

The **Prognosis** of a carbuncle mainly depends upon the condi of the internal organs. If the patient is a confirmed sufferer fr diabetes or albuminuria, there is always considerable risk of sinking from exhaustion. The vascularity of the parts also influe the result, as although there is more reparative power about a vasc region like the face, yet the implication of large veins may lea embolic pyæmia.

Treatment must always be of a tonic, supporting character. G food, iron, quinine, and alcohol according to judgment, mus administered, whilst appropriate medicine (*e.g.*, codeia or opium) limitation of diet are necessary in diabetic patients. Locally, m different forms of treatment have been suggested. The most thoro and satisfactory is to lay the carbuncle freely open under an a thetic, and scrape with a sharp spoon or cut away all sloughs healthy tissue is reached, and then to thoroughly disinfect the c with pure carbolic acid or peroxide of hydrogen (10 volumes). hollow thus formed is stuffed with antiseptic dressings, such as g soaked in an iodoform emulsion (10 per cent.), and the case will probably do well. Another less radical proceeding is to make a crucial incision, and allow the sloughs to separate naturally, assi matters by antiseptic poultices.

In the early stages, it has been proposed to inject the surroun tissues with pure carbolic acid in the hope of destroying the organi and thus preventing suppuration. In a certain number of cases object will be successfully accomplished, but where the organi are at all virulent, it will probably fail.

A **Corn** (*clavus*) is a localized outgrowth of the epidermic laye the skin, together with a central ingrowth of a hard, horny p

which compresses and causes atrophy of the underlying papillæ, constituting a cup-shaped hollow, whilst the surrounding papillæ are hypertrophied. It is the presence of this central plug that constitutes the difference between a true corn and a simple callosity or diffuse overgrowth of the epidermis. Any abnormal pressure is capable of producing either condition, granting that it is not sufficiently severe or intense to lead to ulceration; but it is rare to find corns except on the feet, and the chief cause is badly-fitting boots. Two kinds of corns are described, viz., the hard and the soft.

The **hard corn** usually occurs on the little toe, or over the head of the metatarsal bone of the great toe, or over the heads of the first phalanges of the other toes, especially if there is any tendency to hammer-toe. They form more or less conical swellings, with a dark, dry, central plug, and are often very painful, especially when rain is threatening. Suppuration sometimes occurs beneath a corn, and the pain then becomes acute. **Treatment** consists in paring the corn, after softening with hot water or treating with salicylic acid plaster (10 or 20 per cent.), or painting with a solution of salicylic acid in collodion.* A circular ring of felt plaster may subsequently be worn, but attention must be directed to the boots, and the cause of the trouble removed. Occasionally, where the toe is deformed, it is necessary to perform amputation.

A **soft corn** occurs between the toes, and owing to the absorption of sweat the surface looks white and sodden; it is often extremely painful. **Treatment** consists in removing the thickened cuticle after the use of salicylic acid. The parts are very carefully cleansed night and morning, and spirits of camphor painted on at night, whilst cotton-wool is worn between the toes during the day.

Perforating Ulcer of the Foot forms on some part of the sole and progresses deeply so as to involve sooner or later the bones and joints. It is usually due to two main factors, viz., *anæsthesia* of the soles, and more or less persistent *traumatism*, such as arises from wearing a tight boot or from the presence of a nail, which is not noticed owing to the concurrent anæsthesia. It is therefore likely to be met with: (1) In certain central nervous diseases, *e.g.*, tabes dorsalis, syringomyelia, spina bifida, etc.; (2) in diseases such as diabetes, syphilis, alcoholism, etc., which lead to peripheral neuritis; and (3) as a sequence of traumatic lesions of the nerves affecting any portion of their course from the spinal cord downwards. Thus, a short time back one of us amputated a foot which was painful and deformed as the result of a healed perforating ulcer which had involved bones and joints, and

* The following is a useful formula:

℞. Acidi salicylici, gr. xv.
Ext. cannabis ind., gr. viii.
Sp. vini rect., ℥xv.
Ætheris, ℥xl.
Collodion flexile, ℥lxxv.
M. Ft. pigm.

Sig.: 'To be painted on with a brush three times a day for a week.' —R. CROCKER.

was due to a severe lesion of the lower lumbar region, involving the cauda equina, received thirty years previously. (4) Perforating ulcer is occasionally due to pure plantar lesions, apart from any nervous influence, *e.g.*, a suppurating wart or corn, or even a chronic epithelioma. The skin under the head of the first metatarsal is the part most frequently affected, but any spot to which undue pressure is directed may become involved, and not uncommonly several such sores may be seen on the same foot. A corn or callosity first forms, and under this a bursa, in which suppuration takes place, the pus tending to travel not only to the surface, but also deeply, so as to involve bones and joints. A typical perforating ulcer presents the appearance of a sinus passing down to the deeper parts of the foot, the orifice of which is surrounded by heaped-up and thickened cuticle. There is usually but little discharge and often no pain. If allowed to progress without treatment, the bones and joints of the foot may be extensively destroyed, or may be welded together into a solid painful mass, in either case necessitating amputation; but if taken in hand early, a cure can in some cases be established by carefully paring away the thickened mass of cuticle, purifying the sinus, and protecting the parts from pressure.

A **Wart** (*verruca*) is a papillary overgrowth of the skin, which may manifest itself in many different appearances. The common wart is a horny projection about the size of a split pea, usually seen on the hands of young people; its surface may be smooth or irregularly filiform, and its colour varies with the amount of dirt ingrained on the surface. When smooth-topped, they are sometimes extremely numerous, and may be a little difficult to distinguish from lichen planus. In parts where there is a certain amount of moisture warts become soft in character, and form large vascular masses, *e.g.*, venereal warts. The best method of treating ordinary warts is to paint them with glacial acetic acid, or some other caustic, every two or three days, after softening and removing the horny crust with salicylic acid.

Verruca Necrogenica (see p. 243).

Tuberculous Affections of the Skin.—Lupus.—Although the term 'lupus' is usually and correctly applied to a tuberculous affection of the skin, yet it is also sometimes employed to indicate any chronic inflammation of the skin which tends to spread, and results in replacement of the cutaneous structures by fibro-cicatricial tissue with or without ulceration. In this place we shall deal with the ordinary **Lupus Vulgaris**, which is universally acknowledged at the present day to be of tuberculous origin.

It is met with in children and young adults, rarely commencing after the age of thirty. Its most common situation is the face, usually starting on the nose or cheek. It is rare on the scalp, but fairly frequent on the trunk and extremities. The mucous membrane of the nose and mouth is also attacked, but in such cases the disease usually spreads to it from the skin. It is rarely symmetrical, except when commencing on the nose.

Clinical Features.—The earliest manifestation of lupus consists in the formation of one or more shot-like nodules in the deeper layers of the skin, which are surrounded by a zone of hyperæmia and infiltration. These nodules are not particularly hard to the touch, but when of any size can be demonstrated to be of a brownish-orange tint, especially if they are devascularized by the pressure of a glass slide, and then the colour somewhat resembles that of apple-jelly. Gradually the process extends, and usually more rapidly in one special direction, following the course of the vessels. At the same time the integument becomes infiltrated and transformed into granulation or cicatricial tissue, covered by a layer or two of epithelium, and owing either to degeneration of the tuberculous nodules, or to a lack of vitality, arising from compression of the vessels by the contraction of this new formation, ulceration is very liable to follow. In the extremities the lupoid growth not unfrequently takes on a warty aspect, somewhat similar to the 'anatomical wart' occasionally seen on the knuckles of post-mortem porters (p. 243).

A **Lupoid Ulcer** usually spreads at one margin as it heals at the other, and hence under typical circumstances is more or less crescentic in shape, although this is frequently interfered with by various causes. The surface is covered with granulations, often of a protuberant nature. The edges are raised and infiltrated, and scattered lupoid tubercles are readily distinguishable, extending into the healthy tissues, which are usually red and congested. A considerable amount of sero-pus is often secreted, and this by drying forms thick scabs. Any cicatrix which results from natural processes of cure is thin and vascular, easily breaking down from any slight irritation. The process extends gradually, with or without intermissions, from the seat of its first appearance, being, as a rule, distinctly limited to the cutaneous tissues; but when it attacks the nose, the cartilages are often involved and destroyed, whilst if it involves the palate or septum nasi, perforation is very likely to ensue. The disease is practically painless, and does not at first affect the general health. Neighbouring lymphatic glands may become inflamed, and in some few instances are the seat of a tuberculous deposit. Even if left to itself, it tends sooner or later to come to an end, the ulcerated parts cicatrizing, but leaving indelible traces of its ravages in the shape of obvious scars, with often considerable loss of substance. Occasionally it persists, in spite of treatment, and then an epithelioma may in time develop on the site of the mischief, running a rapid course owing to the vascularity of the part.

Pathological Anatomy.—The characteristic microscopical feature of lupus lies in the formation of nodules around the smaller vessels of the skin (Fig. 112), consisting chiefly of a mass of round cells, within which may perhaps be observed a giant cell and epithelioid cells, arranged in the same way as in tubercle. The structures around are infiltrated and hyperæmic, and as the disease progresses, the original tissue of the part disappears, and is replaced by granulation or fibro-cicatricial tissue. The bacilli are by no means readily found, and are always few in number.

The **Diagnosis** of lupus from syphilitic and other destructive a tions of the skin turns on the presence of outlying nodules beyond spreading edge of the lesion, together with the apple-jelly-like gran tions, and the thin, congested character of any cicatricial tissue pres whilst the slow, though continuous, progress, and the tendency to l at one part as it spreads at another, are also suggestive of its prese The age and constitution of the individual, and the persistence of disease in spite of treatment, must also be taken into account.

The **Treatment** of lupus has been greatly modified of recent ye and is now in a much more satisfactory condition than forme owing to the discovery of the remedial properties of X rays, Fin light, and other agents. In the old days free removal of the dis

FIG. 112.—SPREADING MARGIN OF A PATCH OF LUPUS. (ZIEGLER.)

a, Normal epidermis; *b*, normal corium with sweat-gland (*i*); *c*, focus of lup tissue; *d*, vascular nodule surrounded by diffuse cellular infiltration; *e*, n vascular nodule; *f*, strings of cells in course of lymphatics; *g*, lupoid ulc *h*, proliferating epithelium.

was recommended, either by knife, sharp spoon, or caustics; but results were poor, recurrence being common and the cosmetic eff bad, since healthy and diseased tissues were removed together.

The *Finsen-light cure* consists in exposing the lupoid tissue to c centrated electric- or sun-light, which is focussed on the skin throu an inverted telescope, and finally passes through a rock-cry chamber full of cold running water, so as to eliminate the heat ra It is important that the water-chamber should be pressed firm against the skin so as to devascularize it during the applicati Each sitting lasts for one and a quarter hours, and an attendant wh eyes are shielded by dark glasses controls the crystal water-chamb keeping it firmly against the skin, and slightly shifting it from time time so that an area about as large as a shilling shall be acted u

at each séance. Slight inflammatory phenomena follow, and a local leucocytosis supervenes, as a result of which the disease disappears, and a soft supple scar is produced, which is very little obvious. It is plain that this treatment is very expensive and tedious, and requires constant watchfulness on the part of the operator. It has been found of most value where ulceration is absent and the patch not of great size

X-ray treatment is also valuable. The same precautions as to protecting healthy parts must be observed as in treating cancer (p. 210). The best results have been obtained by using a tube of comparatively low vacuum, and by working for a definite inflammatory reaction, and then stopping till this has disappeared. The length of the exposures necessarily varies, but, as a rule, three to six exposures a week of not more than ten minutes each will suffice. The X rays appear to act best on the ulcerative and fungating forms of lupus, which clear up and heal over; but the cure is only up to a point, as the scars are frequently found to contain small nodules over which the rays have no further influence. For these the Finsen light may be employed beneficially; but in the absence of this agent they may be dealt with by scraping with a lupus spoon, and subsequently applying solid nitrate of silver, acid nitrate of mercury on a match end, chloride of zinc as a paste, or even the actual cautery.

In some bad cases with much ulceration and when there is a superabundance of granulations it may be wise to remove these with a sharp spoon as a preliminary measure, and then hand the patient over to the radiographer. The surgeon must remember, however, that he is not operating to cure the disease, but merely to lay bare the deeper tissues in order that the rays may reach them more effectively. He must not include in the scope of his operation healthy tissues.

For positions which are inaccessible to the ordinary means of applying X rays or electric light—*e.g.*, the back of the throat, the interior of the nose, etc.—the high-vacuum electrode of the high-frequency machine, which gives off X rays, is useful.

Whilst this light treatment is proceeding, the patient's health must be attended to, and a course of suitable tonics administered. An open-air life, as nearly assimilated to the sanatorium type as possible, is also desirable.

Lupus Erythematosus is a disease the nature of which is not yet satisfactorily determined. The appearance of the affection is tolerably characteristic; it is usually situated on the face, and in the most typical cases symmetrical patches are formed over the root of the nose and cheeks, corresponding in appearance to a butterfly with outspread wings. There is a considerable tendency for it to invade the forehead, ears, and scalp, and it occasionally appears on the trunk, and may then be unilateral. It appears as a smooth hyperæmic surface, covered with a branny desquamation; the scales consist of inspissated sebum, and are continuous with deep plugs, which can be traced into the mouths of enlarged sebaceous follicles. As the disease spreads peripherally, the older and central portions are transformed into cicatricial tissue of a pale, thin and white type, in

marked contrast to the hyperæmic condition of the advancing marg
It is usually seen in adults, and more frequently in women than m
Progress is exceedingly slow, and ulceration uncommon, except wh
the ears or scalp are involved; in the latter region the hair is of
lost. Epithelioma has also been known to follow this affection.

The **Treatment** consists in attention to the general health, toge
with the local application of weak tarry and mercurial preparati
The X rays and Finsen light act rapidly, but must be used w
caution, since the inflammatory disturbance caused by them is c
siderable.

The so-called **Tuberculous Ulcers** differ from the lupoid in the
that they always result from the breaking down of a subcutane
focus, and hence may be connected with diseases of bones, joi
lymphatic glands, or simply of the connective tissues. Their charac
and treatment have been already indicated (p. 164).

Other cutaneous manifestations of tubercle are recognised, but n
scarcely be mentioned here.

Affections of the Nails.

Onychia is almost always due to the infection with pyogeni
other organisms of the matrix, starting at the side or base of the
under the semilunar fold. Two varieties are described:

1. **Onychia Purulenta** (*Peri-onychia*, or *Ungual Whitlow*) is an affec
of the matrix commonly seen in surgeons and nurses, in which suppu
tion occurs beneath the nail, which is thereby loosened; the indivi
attacked is generally out of health. The condition usually start
one side, and gradually extends round the semilunar fold and ben
the nail, until the whole matrix may be affected. When the loose
nail is cut away, it is found that the diseased portion of the matri
converted into granulation tissue. The process is extremely pai
and somewhat tedious. The only hope of checking its progress
in removing with fine scissors, possibly under an anæsthetic, all
loosened portion of the nail, and then touching the exposed gran
tions with nitrate of silver, whilst the most comforting applicat
are without doubt linseed-meal poultices, possibly made with
carbolic lotion (1 in 40), and frequently repeated. At the same
the general health must be attended to.

2. **Onychia Maligna** is the term applied to a somewhat sin
condition met with in badly-nourished children, who are pe
syphilitic. The whole matrix is transformed into granulation t
whilst the digit becomes swollen and club-shaped. Treatment co
in avulsion of the nail from its bed, and the application of anti
fomentations or poultices, together with iodoform.

Ingrowing Toenail is an ulcerative condition of the soft parts cu
over the side of one of the toenails (usually that of the great toe)
due either to the pressure of pointed or badly-fitting boots, or to ne
in trimming the nails. The fold of skin is thus pressed by the
over and against the nail when the patient walks, and in ord

diminish the pain and irritation caused thereby, he often cuts away the projecting angle of the nail, but leaves a deep corner which still further irritates the soft parts. Ulceration ensues, accompanied by an offensive discharge and so much pain as to prevent the patient from walking. The matrix of the nail may also become inflamed, and onychia result. In the earliest stages, further progress can often be prevented by careful attention to the nails, by the use of square-toed boots fitting easily, and by introducing small plugs of aseptic wool to press back the overhanging fold of skin. When ulceration is actually present, the best plan to adopt is the removal of the affected half of the nail under local or general anæsthesia, giving special attention to the extraction of the projecting angle. If there is much discharge, it is also wise to cut away the overhanging fold of skin with scissors, and scrape away any granulations present. The parts are then dressed antiseptically, and in a few days the patient is able to walk about. Where there is no ulceration, a cure can sometimes be effected by excising an oval portion of skin from the side of the toe and close to the nail. The edges of the incision are drawn together by horsehair, and thus the overgrowing fold of skin is drawn away from the nail (Fig. 113).

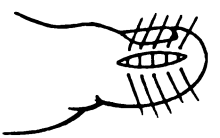


Fig. 113

The term **Onychogryphosis** is applied to a hypertrophic condition of the nails, which become distorted and bent, or twisted up, perhaps simulating a ram's horn. It is usually limited to the great toes of elderly people, and is due to neglect. The nails are very rough, and often covered with grooves or ridges, whilst beneath them is an accumulation of soft, offensive epithelium. The only treatment is removal.

Affections of the Sebaceous Glands.

Sebaceous Cysts occur on any part of the surface of the body, but especially the scalp, and are due to obstruction of the duct of a sebaceous gland. They are rounded swellings, firm and elastic to the touch, moveable on the deeper structures, and always attached at one spot to the skin. On careful examination, the obstructed mouth of a sebaceous follicle can usually be seen, and possibly some of the contents of the sac squeezed through this opening. The cyst wall is formed by several layers of epithelium, surrounded by dense fibro-cicatricial tissue, and if exposed to irritation or pressure, as when situated on the back or shoulder, and rubbed by the braces, becomes very firmly adherent to the surrounding parts. The material contained within is of a cheesy, pultaceous consistency, with a peculiar stale odour, yellowish-white in colour, and under the microscope is seen to be composed of fatty and granular débris, epithelial cells, and cholesterine. Left to themselves, the cysts may attain considerable dimensions, whilst the walls and contents sometimes become calcified. Occasionally the exudation oozes through the duct, and dries on the

surface, with just sufficient cohesion to prevent it from falling layer after layer of this desiccated material is deposited from be finally giving rise to what is known as a **Sebaceous Horn.** Th become dark in colour from admixture with dirt, and are always s or less fibrillated in texture; the base, to which they are firmly adhe is infiltrated and hyperæmic. Sebaceous cysts sometimes infl and suppurate; sooner or later they burst or are opened, and then process subsides. They are occasionally cured in this way, but m frequently the cyst fills up again, and the same series of phenom are repeated after an interval. Should the contents only parti escape, the remainder is liable to undergo putrefactive changes, gi rise to an offensive ulcerated surface with raised edges, which r readily be mistaken for epithelioma. It is sometimes known as *C Peculiar Tumour.* True malignant disease of an epitheliomatous na is said occasionally to supervene.

Diagnosis.—From a *dermoid cyst* it is known by the facts that dermoid is congenital in origin, that it is limited to certain locali whilst it is hardly ever directly attached to the skin. From a *j tumour* it is recognised by the absence of lobulation, and by its m solid character, whilst a lipoma is softer and more moveable. F a *chronic abscess* it is distinguished by the dilated orifice, by its fir consistency, and by the history, but it is sometimes impossible t certain before incising it.

Treatment.—A sebaceous cyst should be entirely and comple removed if giving rise to any disfigurement, inconvenience or p In the scalp all that is needed is to transfix the tumour, squeeze the cheesy contents, and then the cyst wall can be readily remo by grasping it with dissecting forceps and pulling it away. In o situations the cyst wall may require to be dissected out; but e then it is advisable to open it by transfixion, and to deal with the from below rather than from above. Horns and fungating ul should be excised with the surrounding skin.

Sometimes a true **sebaceous adenoma** may develop in connection w these cysts. It may be slowly-growing and of a firm, solid consisten but sometimes it is much more vascular and grows rapidly. The la has a form of semi-malignancy in that it is very liable to recurre and has therefore often been mistaken for a sarcoma. On microsc section it closely resembles a rodent ulcer, but its clinical histo quite distinct. Its most frequent situation is the scalp, and it requ to be removed with a free hand, the defect in the scalp being m good by Thiersch-grafting.

Molluscum Contagiosum.—This affection shows itself in the fo of a number of firm hemispherical nodules, a little larger than a s pea, usually of a yellowish-white colour, and very definitely umbilica The depression in the centre may be occupied by dry débris, and fr the larger ones a waxy mass may be expressed. They are usu seen on the face, but may involve any part of the surface of the bo There seems no doubt as to their contagious properties, this bi perhaps best seen in the development of growths of this nature (

mother's breast, secondary to those on the face of her baby. The cause of the contagion is by no means certain, whilst the exact nature of the affection is also more or less in dispute, since, although some authorities consider it sebaceous in origin, others are equally insistent that it commences in the hair follicles or deep layers of the rete. Pathologically, the tumours consist of numerous wedge-shaped lobules of polygonal, nucleated, epithelial cells, supported by a fibrous stroma. The cells towards the centre undergo a waxy or hyaline degeneration, and in them are seen numerous rounded bodies, which have been supposed to resemble psorosperms. *Treatment* consists in cutting or pulling them away, or in cutting them across, and squeezing the contents out from the well-defined capsule.

CHAPTER XVII.

AFFECTIONS OF MUSCLES, TENDONS, AND BURSÆ.

Injuries of Muscles and Tendons.

Contusion.—Muscles are bruised as a result of blows or falls, leading to more or less extravasation, with possibly some rupture of the fibres. The part becomes tender and swollen, and any active contraction gives rise to pain; passive movement, however, is tolerated if the injured fibres are not thereby put on the stretch. Fomentations and rest may be needed for a few days; but friction, with stimulating embrocations and liniments, and regular massage of the parts, are subsequently necessary.

Sprains and Strains, due to violent efforts or falls, result in the tearing or stretching of some of the fibres. Considerable stiffness follows, especially in rheumatic and gouty patients. Rest and either hot or cold applications may be used at first; but friction with liniments and passive movements will be needed later. In individuals predisposed to the development of tuberculous disease, special precautions must be taken to ensure complete recovery.

Rupture of the Sheath of a muscle is an accident occasionally met with, especially in the biceps cubiti or rectus femoris. The belly of the muscle, when contracted, protrudes through the opening as a hernia, constituting a soft semi-fluctuating swelling. In treating this condition the limb must be kept at rest in such a position as to relax the muscular fibres and allow the rent in the fascia to heal. In old-standing cases it is justifiable to cut down and expose the opening in the muscular sheath, the edges of which are sutured together, or if this cannot be effected a sterilized sheet of silver foil may be stitched over the defect.

Displacement of Tendons rarely occurs, except in parts where these structures pass through osseo-fibrous canals, and particularly in those where the line of action is thereby changed. During some violent effort the patient feels a sudden localized pain, followed by a certain amount of limitation of mobility. This accident is popularly known as a 'rick.' In superficial parts the displaced tendon can sometimes be distinctly felt in an abnormal position, and this becomes more evident on attempting to move it. Thus the long tendon of the biceps may be dislocated from the bicipital groove; and various

tendons about the wrist or ankle, especially that of the peroneus longus, may similarly suffer. If left alone, the parts settle down more or less comfortably, but some permanent weakness may persist; recurrence is very likely to ensue if movement is permitted before the newly formed connections have had time to consolidate.

Treatment consists in fully relaxing the muscles and replacing the tendon, if possible, by manipulation. The parts are then immobilized and well supported for six or eight weeks by a plaster of Paris splint or strapping. If the displacement recurs, it is sometimes advisable to cut down, expose the tendon, and stitch it back into position, using early passive movement to prevent the formation of troublesome adhesions. This is required most frequently in the case of the peroneus longus tendon, which slips forwards from its groove behind the external malleolus. The external annular ligament is thereby ruptured, and the operation consists either in suturing the divided segments, or in more aggravated cases it may be necessary to turn down a flap of periosteum from the malleolus and by stitching its apex to the outer side of the os calcis secure the tendon in place.

Rupture of Muscles and Tendons is by no means uncommon, resulting from excessive violence of a sudden and unexpected nature. Most frequently the tendon gives way at its union with the muscular belly; less often the belly itself yields, whilst occasionally the tendon may snap, or the point of bone to which it is attached may be torn off.

Signs.—The patient at the moment of the accident experiences a sharp and severe pain, as if he had been struck with a whip; he may also feel or hear a snap. Loss of function follows, together with a certain amount of swelling and bruising, which is more evident if the muscular fibres have been torn across than if the tendon alone has been lacerated. On attempting to contract the affected muscle, the belly rises up as a soft, rounded, semi-fluctuating tumour, drawn towards the uninjured attachment, if the union between the tendon and belly has given way; whilst if the lesion has been through the muscular substance, the divided halves of the belly become similarly prominent, and a distinct gap or sulcus can be felt between them.

Repair is established in the usual way already described (p. 245), viz., a cellulo-plastic effusion is first poured out, taking the place of the blood-clot, which is absorbed; this becomes vascularized into granulation tissue, and finally cicatricial tissue is developed. Where a muscular belly is involved and the ends are much separated, a long and weak bond of union is likely to form; but when they are closely apposed, the cicatrix is a short one, and may sooner or later be replaced by true muscular tissue. When a tendon has been divided or torn, the connecting medium is at first attached to the sheath, and if this adhesion persists, it may lead to much pain and weakness. It is an exceedingly interesting fact to note how rapidly this tissue attains a considerable degree of strength; a rabbit's tendon ten days after division requires a weight of 56 lbs. to break it (Paget).

Treatment.—It is essential to relax the parts fully so as to prevent separation of the divided ends, and to maintain them in this position

for two or three weeks. Any resulting stiffness is combat passive movements and massage, whilst, if need be, adhesic broken down under an anæsthetic. Tendons accidentally divi open wounds should be sutured together by catgut, special ant precautions being adopted to prevent suppuration along the sheaths. Where there has been actual loss of substance in a t it is possible to remedy the defect by g a portion of tendon from another pati from an animal, between the two en again, one end may be split longitudin such a way as to leave a thin flap at peripherally, so that the free end (*a*) turned down and united to the other s (Fig. 114). Care must be exercised t vent opposing muscles from dragging stretching the new bond of union, as t considerable functional disability may Thus a young man had his anterior muscles divided by a stab with a knife were carefully sutured together, but convalescence the foot was allowed to d result being that the muscles and t were stretched, and hence the most vi contractions had no effect in raising th which dragged along the ground. A operation to shorten all these structur required.

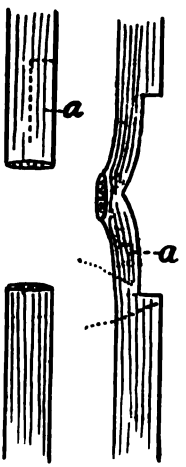


FIG. 114.—METHOD OF UNITING TENDON AFTER LOSS OF TISSUE BY TURNING DOWN A PORTION OF IT AS A FLAP.

When muscular bellies have been d it is not difficult to secure them, if the have been severed longitudinally or obl but when the section is transverse, the great tendency for the stitches to cut out. In such a cas advisable to encircle with a ligature a bundle of muscular fib either side of the incision, and then tie the two threads to This must be done at several spots in the cross-section.

The *long tendon of the biceps* is not unfrequently torn fro muscular belly, which, on attempting to bend the arm, is down towards the elbow, constituting a soft tumour, sou resembling a lipoma. No special treatment is needed beyon ing the fore-arm flexed for a time. If the *tendo Achillis* is ru union may be attained by keeping the knee bent and the heel as by securing a strap to the back of a slipper below, and to collar passed round the knee above. A better result, ho would follow an aseptic incision and suture. Similarly, if th *mentum patellæ* gives way, suture through an open wound i satisfactory than mere elevation of the leg and rest. The in *of the gastrocnemius* is sometimes torn in wrenches or slips, as t tennis, and the *plantaris* is similarly affected. Cooling lotio applied for a few days, and the parts are kept at rest until the

ness and swelling have in part subsided, and then regular massage is undertaken. The *adductor longus* may be lacerated in violent attempts to maintain a seat on horseback, and constitutes one form of riders' sprain; it is treated by rest and the application of a firm spica bandage.

Diseases of Muscles.

Inflammation of Muscles (Myositis) may arise from a variety of circumstances, but the chief results are alike, whatever the cause, viz., a more or less painful infiltration of the muscle, with increased discomfort on attempting movement. The part feels hard and rigid, and may be tender to the touch. If suppuration ensues, the ordinary signs of an abscess subsequently make themselves evident. A certain amount of contractile tissue is thereby destroyed, and the cicatricial changes induced will possibly lead to deformity.

Varieties.—1. **Simple Traumatic Myositis** results from contusion or laceration of the fibres, and is merely a plastic inflammation, with or without hæmorrhage, running on to resolution, with perhaps a little fibroid thickening of the part. It is liable in some cases to become chronic, the muscle substance becoming shortened and replaced by fibrous tissue (*M. fibrosa*), and this fibrosis may extend beyond the limits of the original lesion. The induration of the sterno-mastoid muscle met with in children is of this type, and may lead to torticollis. In other cases ossification of a limited portion of the muscle or tendon may occur from long-continued and frequently-repeated irritation; thus, in riders (male) the upper portion of the adductor tendons may in this way become bony, constituting the so-called 'riders' bone.' Sir William Bennett* has pointed out that a similar type of sprain followed by inflammation and wasting of the muscles occurs in women from riding, involving the hamstrings (particularly the biceps), and possibly being mistaken for sciatica.

2. **Rheumatic Myositis** usually results from exposure to cold, *e.g.*, wry-neck from sitting in a draught. It is treated by fomentations and ordinary saline anti-rheumatic remedies, whilst later on friction with stimulating embrocations is needed.

3. **Acute Suppurative Myositis** is the outcome of infection with pyogenic organisms, either from without, as after operation wounds, punctures, gunshot injuries, gangrene, etc., the pus in such cases spreading widely up and down the muscular planes; or from within the body, as in pyæmia; or by extension from neighbouring suppurative foci, as from subperiosteal abscesses; it may also arise after a contusion or sprain by auto-infection. Great cicatricial deformity is likely to follow.

4. **Chronic Tuberculous Myositis**, with the formation of a chronic abscess, is not an uncommon secondary consequence of a similar affection of neighbouring bones or joints—*e.g.*, a psoas abscess.

5. **Syphilitic Disease** is usually met with in the tertiary period, and takes the form either of a diffuse sclerosis or of a localized gumma.

* *Clinical Journal*, November 9, 1904.

Any muscle may be affected, but perhaps the tongue and sterno-mastoid are those most frequently involved. Care is needed in making a diagnosis, since these conditions resemble tumours in their method of onset; but the presence of a syphilitic history, the slow growth, the hardness, with subsequent central softening, and the rapid disappearance after the administration of iodide of potassium, should suffice to determine their nature.

Occasionally gummata appear in muscles in the shape of small hard and shotty nodules, usually arranged more or less longitudinally, which are painless and apparently attached to the fascial sheath. They react readily to iodide of potassium

6. **Parasitic Myositis**, arising from the presence either of the *Trichina spiralis* or of hydatids, need not be described here.

7. **Myositis Ossificans** is a rare disease, in which various muscles, especially those of the back, are transformed into bony plates or rods, so as to lead to extensive ankylosis. The process seems to be one of ossification of the connective tissue associated with atrophy of the muscular fibres, and is sometimes extremely painful. It is most commonly seen in young males, and is possibly rheumatic in origin. In a boy recently under observation the arms were immobilized by ossification of the latissimus dorsi muscles on either side, whilst the pectoralis major was also ossified on the right side. The erector spinæ was involved, the back being thus rendered rigid, and the right trapezius was undergoing the same change. This disease is not unusually associated with a congenital deformity of the great toes in which the proximal phalanx is absent or stunted. No treatment has proved of any value.

Tumours of Muscles are not very common. Primary growths consist of angioma, fibroma, chondroma, myxoma, or sarcoma, and of these the majority start in the fibrous sheaths or the interfibrillar connective tissue. Secondary deposits of both carcinoma and sarcoma occur, but there is nothing special to be noted about them. *Treatment* must be determined on ordinary surgical principles. If sarcomatous, the whole thickness of the muscle should, if possible, be excised for some distance from the growth, since the lymphatics run in the direction of the fibres, but the sheath forms a limit not early overstepped. Amputation of the limb may, however, be required.

Diseases of Sheaths of Tendons.

The synovial membranes which line the sheaths of tendons may become inflamed as a result of injury or infection.

1. **Acute Simple Teno-Synovitis** often follows sprains and strains, and is most commonly seen in connection with the extensor muscles of the thumb. A puffy swelling in the course of the tendons is produced, painful on movement and perhaps tender to the touch, giving a characteristic fine crepitus whenever the parts are moved. All that is needed for its **Treatment** is to immobilize the limb for a few days, and apply fomentations. As soon as the more acute

symptoms have disappeared, friction with stimulating embrocations and pressure are employed to hasten the absorption of the fluid; whilst active and passive movements are undertaken to prevent the formation of adhesions.

2. **Acute Suppurative Teno-Synovitis** may result from a punctured wound of the synovial sheath, or the inflammation may spread to it from neighbouring tissues. The thecal variety of whitlow (p. 244) is of this nature. Suppuration may extend both up and down the sheath, and unless promptly treated by incision, the tendon will slough, or may contract extensive adhesions to neighbouring parts; in either case considerable impairment of function follows. The suppuration may affect neighbouring articulations, leading to their disorganization, especially in the case of the tendon sheaths around the wrist-joint.

3. **Chronic Simple Teno-Synovitis** is a common affection, characterized by a passive effusion into the tendon sheath of glairy synovia, somewhat resembling uncooked white of egg. It may be limited in extent, constituting one of the varieties of ganglion, or diffuse. An elastic fluctuating swelling forms in the course of a tendon, usually associated with creaking. There is no pain or tenderness, but the affected part feels weak. **Treatment** consists in counter-irritation and pressure, as by Scott's dressing; failing this, the part may be freely incised, the synovia removed, and, if need be, the cavity washed out. In the more localized forms it may suffice to puncture the cyst-like swelling and squeeze out the contents, pressure being subsequently applied.

4. **Chronic Tuberculous Teno-Synovitis** is of two types. In one the sheath is lined by œdematous granulation tissue of some thickness, containing tuberculous foci, giving rise to a soft elastic swelling along the course of a tendon, which increases slowly in size, and is but slightly painful or tender. Suppuration may follow, and subjacent bones or joints be involved. **Treatment** consists in immobilizing the part, pressure, and improvement of the general health. If a cure is not quickly established, a free incision should be made and the diseased tissue removed.

The other form of tuberculous disease consists in a passive effusion into the synovial space, the lining membrane of which becomes thickened by the deposit thereon of fibrinous material. This is often detached, and by the movements of the part the loose fragments of fibrin are moulded into various shapes. In tendon sheaths they are often elongated, and constitute the so-called *melon-seed bodies*; but when they occur in joints, they remain somewhat flattened, and in bursæ approximate more to the spherical. On examination, they are found to be structureless, though sometimes laminated. When numerous they give rise to a curious and characteristic form of crepitus. That they are of a tuberculous nature can be demonstrated by inoculation experiments; the bacilli contained therein are not, however, in a very active state, and the prognosis of this type is more favourable than of the former.

If **Treatment** by immobilization and pressure (as by the applicati of Scott's dressing) fails, the part should be opened, the effusi including fibrin and melon-seed bodies, removed, iodoform gen rubbed in, and the cavity closed, after filling it with glycerine a iodoform emulsion. Should the trouble recur, a free incision a removal of the diseased membrane may be required.

A **Ganglion** is the term given to a localized cyst-like swelling formi in connection with a tendon sheath. It is most commonly met w at the back of the wrist, arising from the tendons of the thumb index-finger, but it sometimes occurs on the front of the wrist or the foot. It varies in size considerably, and contains a clear, tra parent gelatinous or colloid substance, like white-currant jelly. rounded firm elastic swelling is produced, usually somewhat moveal and neither painful nor tender at first, although some painful weakn of the part may be experienced as it increases in size. It is due one of several causes: thus, it may result from a chronic localiz teno-synovitis, or from a hernial protrusion of the synovial membra through an opening in the tendon sheath. Others seem to origin in a colloid degeneration of the cells lining the synovial space; whi certainly some few arise in connection with subjacent articulations; the same way as a Baker's cyst. Little difficulty arises in the diagnos although, when situated deeply and closely attached to a bone, th have been mistaken for exostoses. **Treatment.**—A ganglion m often be ruptured by manipulation and pressure with the thumbs, by a forcible blow with a book, but it is apt to fill again. Faili this, a rapid cure is usually obtained by an aseptic puncture of t cavity, and the subsequent application of firm pressure. In so cases it may be advisable to lay the part open and remove the c wall; such treatment requires absolute asepsis, since, if infecti occurs, most serious consequences may ensue.

A **Compound Palmar Ganglion** consists in a tuberculous affection the common synovial membrane surrounding the flexor tendons of t wrist, the cavity being distended with synovia, usually contain many melon-seed bodies. It forms a large swelling extending abo and below the wrist, fluctuation being readily transmitted from o part to the other beneath the annular ligament; it also exte amongst the muscles of the thenar eminence along the tendon of t flexor longus pollicis (Fig. 64). In the **Treatment**, rest and pressu as by Scott's dressing, together with suitable constitutional remedi may first be tried; and failing this, an incision is made both abo and below the annular ligament, the cavity being well washed o and all melon-seed bodies and fibrinous débris removed. The cav is then filled with the glycerine and iodoform emulsion, some of wh may be gently rubbed into the pockets of the wound; both incisions then firmly sutured, and a further period of rest maintained. Sho the skin become thin and undermined, drainage may be required, a even in a few cases division of the annular ligament, in order to d effectively with the trouble by the sharp spoon. The results, howev are not very good, as the tendons get matted together and adherent the skin, and the movement of the fingers is thereby hampered.

Operations on Tendons.

1. By **Tenotomy** is meant the division of a tendon through an open or subcutaneous wound with the object either of remedying some deformity, such as talipes or torticollis, or of assisting the surgeon to reduce some displacement, as in setting a fracture; thus, the tendo Achillis may require division in fractures of the leg in order to overcome muscular contraction.

Division of tendons is accomplished in two ways, viz., by subcutaneous or open incision. The **subcutaneous** method is made use of where there is little likelihood of injuring important structures. The strictest attention to asepsis is desirable, since the character of the wound, viz., a puncture, and the entire absence of drainage are most favourable to the development of organisms, if entrance is once given to them. Moreover, the synovial tendon sheath is often, though undesignedly, wounded, and septic inflammation would rapidly spread along this structure, and give rise to the most serious consequences. The operation consists in inserting a sharp-pointed tenotome through the skin down to the tendon. This is then withdrawn, and a blunt-pointed knife passed along the track thus made, either superficial to or beneath the tendon. The cutting edge is turned towards it, and the tendon divided by a sawing or rocking movement, whilst the structure is put on the stretch by an assistant. Every effort must be made to avoid opening the sheath, since even if the wound remains aseptic, the tendon often retracts more than is desirable, and in healing gains adhesions to the sheath which considerably limit the subsequent freedom of movement of the part. Opinions vary as to whether it is better to pass the knife above or below the tendon; in the former method there is no likelihood of making an unduly large wound in the skin, and there is less risk of dividing the *lax* subjacent structures if the knife is turned towards them. On the other hand, if the knife is at once passed beneath the tendon, and any such subjacent structures are by mistake included, their division is a matter of certainty. Where, however, there is any risk of dividing important structures, such as the external popliteal nerve in tenotomy of the biceps cruris, it is wiser to adopt the **open method**. In this an incision about 1 inch in length is made over the tendon, which can thereby be exposed, lifted on an aneurism needle, and severed without danger. There is no hæmorrhage worth mentioning, and the wound is closed by a point or two of suture, dressed antiseptically, and firmly bandaged to prevent extravasation. The malposition is at once corrected, and the part immobilized at the time, or in the course of forty-eight hours, in plaster of Paris.

Tenotomy of the Tendo Achillis.—The foot is placed on its outer side, and the tendon relaxed by pointing the toes downwards. The tenotome is introduced at the inner margin of the tendon, about 1 inch above its insertion (Fig. 94, F), either superficial to or beneath it, and it is readily divided when the foot is dorsiflexed. If the surgeon cuts towards the skin, he must not divide the last few fibres too

rapidly, otherwise a considerable external wound may be inflicted by the suddenly liberated knife.

The *Tibialis Anticus* is usually divided about 1 inch above its inser tion, as it crosses the scaphoid (Fig. 96, C). There is here no synovi sheath, and the arteria dorsalis pedis is separated from it by the tend of the extensor proprius hallucis. It is first relaxed so as to allow the introduction from the outer side of the sharp-pointed tenotom beneath it; this is then replaced by a blunt-ended instrument, an the section is readily accomplished when the foot is abducted.

The *Tibialis Posticus* is usually divided together with the flex longus digitorum just above the base of the inner malleolus, at a spo about a finger's breadth from the tip of that process in an infant, an about 1½ inches from it in an adult (Fig. 94, E). A small tuberc can usually be felt at this spot, and the section must be made jus above. The knife is inserted between the tibia and the tendon, an is kept as near the bone as possible. If correctly placed, it remain fixed without the support of the hand, being grasped between th tendon and the bone. The blunt-ended tenotome is then introduce and the edge being turned towards the tendon, the latter structure divided when the foot is dorsiflexed. The posterior tibial vessels ma be wounded if the tendons are too suddenly severed, but even shou this occur, a little well-adjusted pressure will suffice to prevent an serious consequences.

The *Peronei* tendons are divided just above the base of the outer malleolus, at a spot where the synovial sheath is usually absen (Fig. 95, D). The tenotome is inserted close to the fibula, betwee the tendons and the bone.

The *Biceps Cruris* tendon is best divided by an open operation, o account of the close propinquity of the external popliteal nerve, whic has often been wounded in the subcutaneous operation. An incisio is made in the direction of the tendon just above its insertion into th fibula. It is then lifted upon an aneurism needle and divide muscular fibres will probably be found quite close to its lower end.

The *Semi-membranosus* and the *Semi-tendinosus* tendons are dealt wi just above the knee-joint, and the subcutaneous operation may b conveniently adopted when they are prominent and tense.

For division of the *Sterno-mastoid*, see p. 422.

2. **Lengthening a Tendon** is sometimes required, in order to ove come the deformity which results from loss of substance or contra tion, where simple tenotomy does not seem desirable. It may possible to utilize the method suggested on p. 408 for the union of tendon where there has been loss of substance, viz., by bridging t interval by a flap turned down from one end. Perhaps a more efficie method is the so-called **Z**-operation (Fig. 115). The tendon is s longitudinally (*bc*) into two halves, which are separated one from other by cross cuts made on opposite sides, one at each end (*ab* *cd*). The two flaps are then drawn apart for a distance correspond to the increase in length required, and sutured together; the result bond of union will be as represented in Fig. 116.

3. **Shortening a Tendon** is undertaken in some forms of paralytic talipes. The Z-method may also be employed here, the two halves, after they have been separated, being shortened to the required amount, and then stitched together (Fig. 117). This operation will probably give a more solid bond of union than the simpler proceedings in which either a transverse or an oblique section is removed, and the ends sutured together; in such the sutures are much more likely to cut out.

4. **Tenoplasty**, or the incorporation of a strong tendon into a weaker one in order to strengthen it, is rarely undertaken except in talipes, and more particularly in order to reinforce a weak tendo Achillis in paralytic talipes calcaneus, by joining to it a strong and healthy

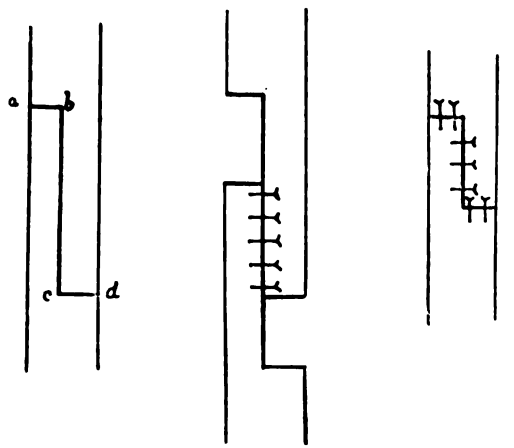


FIG. 115. FIG. 116. FIG. 117.

FIGS. 115, 116, AND 117.—Z-OPERATION FOR LENGTHENING OR SHORTENING OF TENDONS.

In Fig. 115 the method of dividing the tendon is shown. In Fig. 116 the flaps are slipped downwards, one on the other, so as to lengthen the tendon. In Fig. 117 equal portions have been cut away from each half, and the remainders sutured, so as to shorten it.

peroneus longus. In order to make an effective bond of union, the healthy tendon must be threaded through the weak and atrophic one, and fixed by sutures in several places.

Diseases of Bursæ.

Bursæ exist as normal structures in many parts of the body exposed to pressure, their object being to diminish friction and permit of a gliding movement. Similar cavities, known as abnormal or **Adventitious Bursæ**, are developed in regions where exceptional pressure is brought to bear on some prominent structure; they consist of a fibrous wall lined by a serous membrane, contain a small quantity of serum, and are formed either by dilatation of lymphatic spaces, or as

a result of a localized effusion into the tissues. Examples of this are met with in men following special occupations; *e.g.*, over the vertebra prominens of Covent Garden porters, and then known as a 'hummy'. Billingsgate fish-carriers occasionally have bursæ under the centre of the scalp; and deal runners often present one on the upper part of the shoulder. They occur over bony prominences arising from malformation or displacement, *e.g.*, over the cuboid, in talipes equino-varus; over the internal condyles of the femora, in bad cases of genu valgum; whilst the false joint or pseudarthrosis which occurs in unreduced dislocations or ununited fractures is practically of this nature.

Wounds of bursæ may be caused by penetrating injuries, or sometimes by the skin over them splitting, as, *e.g.*, in a fall on the point of the olecranon. The escape of bursal fluid which results often prevents healing, and then it will be necessary either to excise the bursa or to open it freely so that it can be stuffed and made to granulate from the bottom.

The following are the morbid conditions which arise in adventitious as well as normal bursæ:

1. **Acute Simple Bursitis** may result from a non-penetrating injury or from prolonged irritation, especially in gouty or rheumatic individuals. The part becomes swollen, painful, and tender, and if superficial the skin over it may be hyperæmic. Effusion into the cavity quickly occurs, the fluid being spontaneously coagulable in the early stages, and, if resulting from traumatism, mixed with blood. Lymph is deposited on the serous surface, and in many cases results in the formation of adhesions, and possibly obliteration of the cavity. **Treatment** consists in keeping the part at rest, and applying fomentations whilst suitable constitutional remedies are administered. If the effusion persists, aspiration, or removal with trocar and cannula under strict asepsis, may be employed, or even the whole cavity excised.

2. **Acute Suppurative Bursitis** arises from infection occurring either from without or within; it not uncommonly follows a subcutaneous injury of a chronically inflamed bursa, leading to its distension with blood. All the phenomena, local and constitutional, usually associated with the formation of a superficial or deep abscess are present. The pus, formed at first within the bursa, may travel directly to the surface, or, bursting through the capsule, is diffused through the tissues. Where this occurs, the characteristic features suggesting a bursal origin of the abscess may be masked. Thus, in suppuration of the bursa patellæ, the pus often finds its way to the lateral aspects of the limb, allowing the patella to be distinctly felt through the skin; the case might then be mistaken for suppuration within the knee-joint, but is easily distinguished by the absence of the more acute arthritic symptoms. Implication of subjacent bones and joints sometimes occurs; thus, the patella or olecranon may become carious, or necrose. The **Treatment** of suppurative bursitis resolves itself into an early free incision, and drainage.

3. **Chronic Bursitis with Effusion** is, perhaps, the most common pathological condition met with in connection with bursæ. The

cavity becomes distended with a serous effusion of varying amount, giving rise to a fluctuating tumour. The walls differ in thickness according to circumstances; if the condition is one of long standing, or if frequent recurrences have been present, the bursal wall is usually reticulated and dense, and adhesions or fibrous cords are often produced. Subacute exacerbations are frequently grafted on the more chronic variety. **Treatment** consists in rest and counter-irritation, as by blistering or iodine paint, and if this fails, the bursa should be dissected out. When the bursa communicates with a joint, such as that under the semi-membranosus tendon, the neck must be isolated, and its communication with the joint shut off by ligature.

4. **Chronic Fibroid Bursitis**.—In this variety the walls of the bursa become chronically thickened, as a result of prolonged irritation, and also probably from the effect of syphilis. There is but little effusion; consequently, a hard fibroid tumour is met with in the region of the bursa, and in the centre of this is a small cavity. The only **Treatment** is complete removal.

5. **Chronic Tuberculous Bursitis** occurs either in the form of a fibrinous deposit on the inner wall, together with effusion and the presence of loose fibrinous bodies; or the lining membrane undergoes a change analogous to that described as pulpy degeneration of a joint, and perhaps leading to the formation of a chronic abscess. Either condition may be secondary to a tuberculous arthritis, or may give rise to it, when the bursa communicates with a joint. If total removal is impracticable, the **Treatment** consists in laying the part freely open, scraping away all tuberculous tissue, and stuffing the cavity with gauze impregnated with iodoform.

6. **Syphilitic Changes** may also occur in bursæ, in the shape either of a symmetrical bursitis in the early stages, or later on as a gummatous peri-synovial development.

Occasionally **Gouty Deposits** are observed in the walls of bursæ, constituting tophi, the irritation of which may predispose to abscess formation, pus mixed with urate of soda crystals being discharged. The bursa over the olecranon is said to be most frequently affected in this way.

Special Bursæ.

The *bursa patellæ* (Fig. 118), which lies over the lower half of the bone and not over its centre, is very liable to injury and inflammation from its exposed situation, and especially in those who kneel much, giving rise to the condition known as 'housemaid's knee.' Any of the above-mentioned varieties of bursitis may be met with, and their signs are so evident that it is unnecessary to again mention them in detail. The relation of the bursa to the patella explains the fact that acute suppuration sometimes gives rise to caries or superficial necrosis of that bone, whilst chronic and subacute inflammations may lead to thickening of the bone from osteoplastic periostitis.

The bursa beneath the ligamentum patellæ, between it and the head of the tibia, when distended with fluid, gives rise to a fluctuating swel-

ling felt on either side of the tendon, more especially when th is extended; when the leg is flexed, the swelling diminishes. C enlargement of this bursa may cause the ligamenta alaria pushed backwards into the joint, so that they are nipped betwe bones whenever the patient attempts to stand with the leg exte the pain thereby induced is somewhat similar to that caused displaced semilunar cartilage, or by a loose foreign body in the The inability to stand with a straight leg, and the presence enlarged bursa, are sufficient, however, to guide the surgeo correct diagnosis.

The bursæ in the popliteal space are often enlarged, especiall between the inner head of the gastrocnemius and the semi- branosus, leading to a rounded fluctuating swelling, sharply li on its outer aspect, and more fixed and less defined towar

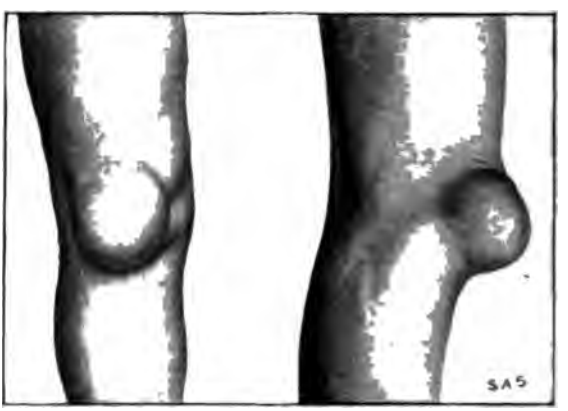


FIG. 118.—ENLARGED BURSA PATELLÆ. (FROM A PHOTOGRAPH.)

inner. The sensation imparted to the fingers varies according position of the limb, the swelling being *tense in extension and flac flexion*, as occurs in most of these peri-articular bursæ. Owing proximity of the popliteal vessels, pulsation is occasionally dete but it is only heaving, not expansile, in character. The fact th bursa usually communicates with the joint necessitates consid caution in its treatment; it should be removed by a careful disse the communication with the joint being closed by ligature or su

The *bursa beneath the insertion of the semi-tendinosus and gracilis* is times inflamed, and is very liable to cause osteoplastic periost the subjacent inner surface of the tibia.

The *bursa beneath the tendo Achillis*, if enlarged, presents a f ating swelling on either side of that structure, somewhat simu disease of the ankle-joint, but necessarily limited to the po aspect of the joint. The enlargement is usually due to the pr of badly-fitting boots.

Distension of the *bursa beneath the psoas tendon* gives rise to

swelling which usually projects anteriorly, presenting on the inner side of Scarpa's triangle. If painful, it necessitates flexion of the thigh, and thus leads to symptoms resembling those of hip-joint disease or of a psoas abscess. It must not be forgotten that this bursa often communicates with the joint.

The *gluteal* bursa, situated between the insertion of the gluteus maximus and the great trochanter, is not uncommonly the seat of tuberculous disease. It presents as a rounded swelling, obliterating the hollow behind the trochanter, and in its more acute manifestations may be accompanied by abduction and eversion of the limb, in order to relax as far as possible the gluteus. It may thereby somewhat resemble the earlier stages of hip disease, but is known from it by the absence of flexion, and the fact that passive movements, including even the so-called test-movement for hip disease, can be undertaken with but little or no pain. Should suppuration occur, the pus may burrow widely beneath the gluteus. Treatment consists of incision, which will necessarily involve a portion of the insertion of the gluteus maximus, scraping and disinfecting the interior of the bursa, and allowing it to heal from the bottom.

The *bursa over the tuber ischii*, if inflamed, gives rise to the condition known as 'weavers' bottom'; it causes great discomfort in sitting, and is often solid and symmetrical. If troublesome, it should be removed.

Enlargement of the *bursa over the olecranon* constitutes the condition known as 'miners' or students' elbow'; suppuration within it is not uncommon, leading to necrosis of the underlying bone; the elbow-joint is but rarely affected.

The large multilocular *subdeltoid bursa* is occasionally enlarged; it leads to prominence of the deltoid, and expansion of the shoulder. (For diagnosis from effusion into the shoulder-joint, see p. 648). Where treatment by counter-irritation and rest fails, the cavity should be incised and drained.

CHAPTER XVIII.

DEFORMITIES.

Torticollis.

TORTICOLLIS, or wry-neck, is a deformity produced by a co of the sterno-mastoid muscle, the trapezius and deep fascia b frequently affected, and occasionally the short muscles at the the neck. It is terized by the side of the he drawn down the shoulder, w face is turned the sound side, a in Fig. 119. W has lasted for so especially in co cases and tho mencing in ch the affected sid head and face atrophic. The m ment from the canthus to the the mouth is the eyebrow arched, the n flected, and th less full than sound side. satisfactory ex of these pheno forthcoming, b are probably imperfect vascular supply. The cervical spine becomes curved, with its concavity to the affected side, and a second pensatory curve is also present in the dorsal region, so as to the eyes as far as possible on a level.

FIG. 119.—TORTICOLLIS.

The right sterno-mastoid is contracted, and the corresponding half of the face atrophic.

The **Causes** and **Varieties** of torticollis may be classified as follows:

1. *Congenital* torticollis, the result of malformation or malposition *in utero*, or of some intra-uterine muscular contraction or nervous lesion.

2. *Muscular* torticollis, due to intrinsic contraction of the sterno-mastoid, apart from nervous influences, as in cicatricial shortening after intramuscular abscess or gumma. In children it is said to follow the congenital induration of the muscle so often seen, and due to laceration during birth, whilst it is not unfrequently met with as a temporary deformity resulting from cold (rheumatic myositis, or stiff-neck).

3. Torticollis arising from *nervous* causes, including spasm and paralysis. *Spasmodic* torticollis (tonic or clonic) may result (*a*) from the direct irritation of the nerve-trunk or its roots, as by inflamed cervical glands or cervical caries; (*b*) possibly from reflex irritation, as by carious teeth, worms or ovarian mischief; and (*c*) from irritation of the deep or cortical centres. This latter variety is usually of the clonic type, and often involves the posterior muscles as well as the sterno-mastoid. The character of the movements varies with the actual muscles involved. It occurs most frequently, though not exclusively, in women of about thirty years of age, and there is often a family history of nervous diseases, such as epilepsy, etc. The prognosis in these cases is almost always unfavourable, since, even if the localized spasm is cured by appropriate operative treatment, other parts are likely to become affected. *Paralytic* torticollis arises either from infantile paralysis of one muscle, leading to unbalanced action of that on the other side, or from some peripheral nerve lesion.

4. *Hysteria* is also responsible for a certain number of cases.

Most commonly the sternal portion is mainly affected, whilst the clavicular half may be quite relaxed. In congenital and cicatricial cases the muscle stands out as a hard tense band, an excess of fibrous tissue being present, or the muscular substance almost entirely absent; but in spasmodic cases the muscle may be well developed and not specially prominent. The deep fascia always becomes secondarily contracted and shortened, and if the deformity has lasted long the posterior cervical muscles are similarly affected, whilst changes in the shape of the vertebræ may also be induced, the bodies becoming wedge-shaped and thickest towards the convexity of the curve.

The **Diagnosis** of torticollis is readily made. It must not be confounded with cicatricial contraction of the skin of the neck following burns, or the attitude temporarily assumed by a patient with an acute deep-seated abscess of the neck, or with tuberculous caries of the spine associated with lateral deviation. The rigidity of the neck in the latter case, together with the pain caused by movement of or pressure over the vertebræ, should suffice to make the diagnosis clear. Rheumatic inflammation of the deeper ligaments and muscles of the cervical spine (rheumatic spondylitis) may also be mistaken for torticollis, but it comes on rapidly, and is associated with tenderness on deep pressure. The fact that in tonic cases the muscle is evidently

contracted, and stands out as a tense band in the neck, is sufficient characteristic. Spasmodic torticollis, again, cannot well be mistak for any other condition, but it may be difficult to distinguish its cau or to localize the affected muscles.

The **Treatment** of torticollis necessarily varies with the cause, a thus either antiphlogistic, antineurotic, antirheumatic, or antisyphili remedies may be required. When, however, it is due to congenital tonic contraction of the muscle or its tendon, massage and manipul tion may be first tried, or even some form of mechanical apparatu but in the majority of cases tenotomy or myotomy will give a mo satisfactory result, and is much less tedious and troublesome.

Two methods of dividing the sterno-mastoid have been employe (1) The *subcutaneous* operation is a somewhat undesirable proceedin on account of the important structures placed immediately benea it. There is but little danger or difficulty in dealing with t sternal head, a tenotome being passed down to it beneath the ski and the incision made from before backwards; the tension to whi it is exposed suffices to draw it well forwards out of harm's wa In dealing with the clavicular portion, it has been recommended introduce a sharp-pointed, and then a blunt-ended, tenotome benea the muscle, dividing it from within outwards, whilst others sugge that a director should first be passed beneath it, and then the musc divided. (2) The *open* method is far preferable to any of these plan as thereby all danger is obviated. The skin is freely incised acro the muscle, its anterior and posterior borders defined, and its fibr carefully and fully divided. No attempt should be made to deal wi the portion of deep cervical fascia which passes beneath it a securely covers in the important underlying structures. Any p of the lower half of the muscle may be selected, but the best spot about $\frac{1}{2}$ inch above the clavicle. The position of the head is th rectified, and fixed by plaster of Paris or some other suitable apparatu A simple and satisfactory arrangement consists of a padded leath strap passed round the forehead and occiput, and another under t axillæ. A chain or elastic band is secured to the forehead str above the mastoid process of the side which is not affected, a traction made by fixing it to the front of the lower belt on t opposite side of the body. Thus, if the left sterno-mastoid is co tracted and has been divided, the chain is attached over the ri mastoid process above, and below over the front of the left axil traction being thus made in the direction of the right or weaken sterno-mastoid muscle. In some cases more efficient support necessary, and may be obtained by the use of Chance's back spl (p. 429), to which arms are attached at the upper end, bringi pressure to bear upon each side of the head in suitable directio Where, however, osseous changes are present, the deformity m persist to a great extent, in spite of combined operative a mechanical treatment.

In cases of clonic torticollis it may be necessary to cut down o and stretch or excise, the spinal accessory nerve (p. 386). This

not attempted until hygienic and tonic treatment has failed. Where the cause is peripheral, good results may follow; but when due to central lesions, as is usually the case, we have already stated that failure is not uncommon. In such, division of the posterior cervical nerves, as they lie on the semi-spinalis colli, will occasionally bring about a cure (Keen); should this fail, it may be justifiable to deal with the cortical centres.

A **Cervical Rib** is a deformity of somewhat unusual occurrence. It arises most frequently from the anterior transverse process of the seventh cervical vertebra, but a similar outgrowth sometimes occurs from the sixth. It is mainly composed of cartilage at first, but as age advances it becomes osseous. It passes down behind the nerves to unite with the central portion of the first rib, and occasionally consists of two portions, an upper and a lower, united together by a synchondrosis. No symptoms are produced until the mass by its growth compresses the roots of the brachial plexus, or pushes the subclavian vessels forwards, thus leading to trophic and vascular disturbances, as well as to neuralgia and some weakness or loss of power in the arm. Nothing should be done to this condition unless pressure symptoms are present, when removal may be required. An incision is made parallel to the anterior border of the lower portion of the trapezius; the nerves and vessels are separated from the mass of cartilage and drawn aside, and the growth carefully excised with gouge, chisel, or cutting pliers.

Deformities of the Spine.

Scoliosis.—By scoliosis is meant a lateral curvature of the spine accompanied by rotation of the vertebræ. Conditions are met with in which the spine becomes deflected laterally as an occasional result of Pott's disease, or in fractures; such, however, are not generally considered to be genuine scoliosis.

Ætiology.—The following are the chief causes of scoliosis: 1. It is said to occur very rarely as a congenital deformity, owing to malformation of the vertebræ. 2. It may commence in young children as a result of *rickets*, owing partly to the softened condition of the bones, partly to their irregular growth. It is probably often induced by the method of always carrying children on the same arm in vogue with nursemaids. A similar change, due to the so-called 'delayed rickets,' may also occur in children who are able to run about. The primary curve in this type is usually one directed towards the left in the dorsi-lumbar region. 3. Any condition of asymmetry of the body may lead to what is known as *statical scoliosis*, *e.g.*, congenital shortness of one leg, unilateral dislocation of the hip, contractions of the knee- or hip-joints, genu valgum, falling in of the chest wall as a result of empyema, and even old-standing torticollis. If the cause exists in one of the lower extremities, the pelvis is tilted down on the side of the shorter limb, unless persistent adduction is also present, producing a lumbar curve with the convexity towards the side of the

shortened leg, whilst a compensatory dorsal curve in the oppos direction is subsequently added in order to maintain the general a of the body. When due to empyema, a primary dorsal curvature produced, with its convexity towards the sound side. In tortico the cervical curve is primary, and a compensatory curve in t opposite direction in the dorsal region usually follows. 4. The m common type, however, is the *scoliosis of adolescents*, met with in you people about the age of puberty, or a little older, who are in a we and asthenic condition, often as a result of rapid growth, combin possibly with improper or insufficient food, defective hygienic su roundings, or exposure to hard work, whereby undue muscular fatig is induced. Young women of an anæmic type who suffer fro amenorrhœa, and who as housemaids or factory hands have to unde take a good deal of lifting, are especially liable to this condition. is due to a relaxed state of the ligaments and muscles, which ha not developed *pari passu* with the weight and length of the skeleto it is therefore not unfrequently associated with flat foot and ge valgum. Prolonged standing in a position of ease or rest, in whic the weight is mainly carried on one leg, may determine its occurrenc as also faulty positions occupied by children at school, owing to lo desks and want of support to the feet. The lumbar curve usual forms first, its convexity being to the left side, a compensatory dors curve, with its convexity to the right, being subsequently develope

The **Phenomena** vary considerably according to the character an extent of the lesion. Sometimes the whole spine is involved in on curve (*total* scoliosis); but more usually two curves are present, on primary, the other compensatory. It is by no means uncommon f this condition to be associated with kyphosis, but the absence of th latter, in what is sometimes termed the 'flat-backed' type, is a criterion of the slightness of the case. The most usual variety is th in which there is a double curve, with the dorsal convexity to th right and the lumbar to the left. It will be desirable to descri this carefully, whilst for the opposite condition all that is necessar is to transpose the words 'right' and 'left,' or, as Hoffa has put i one variety is the 'mirror picture' of the other.

In addition to the lateral displacement, *rotation of the bodies of th vertebræ* (Fig. 121) towards the convexity of the curves is alway present. This is probably a purely mechanical act, and due to th more firm support given to, and the interlocking of, the posterior par of the vertebræ. As a result, the spinous processes are directe towards the concavity, and hence will always indicate a smalle amount of distortion than really exists. Occasionally there may be sou backward projection of the spines at the junction of the two curves

The *thoracic walls* necessarily participate in the process. The ri on the right side become to some extent separated from one anothe and project posteriorly on account of the rotation of the vertebra the amount of curvature at the angle is consequently increased, whil the front of the chest on this side of the body becomes flattened. O the left side the ribs are huddled together, and the curve at the ang

diminished, the ribs being thereby opened out; consequently, the thorax is flattened posteriorly on that side, but projects in front; the left breast may thus be rendered prominent (Fig. 122). In fact, the thorax becomes more or less rhomboidal in shape. The sternum also is somewhat displaced towards the concavity, and twisted so that the anterior surface looks towards the right. The capacity of the thorax is not as a rule affected at first, but in the later stages it is consider-

FIG. 120.—SCOLIOSIS SEEN FROM BEHIND. (TILLMANNS.)

FIG. 121.—SPINE IN SCOLIOSIS SEEN FROM IN FRONT. (TILLMANNS.)

ably diminished, and the abdominal viscera may even be displaced. The *scapulæ* follow the thoracic wall, and hence the right shoulder is pushed upwards and outwards, and this, it is said, in the worst cases may progress to such an extent as to cause the sternal end of the clavicle to be spontaneously dislocated backwards. It is for this 'growing out of the shoulder' in young women that the majority of cases come under observation. The left scapula is generally somewhat lower than the right. The effect on the *waist* varies with the situation and extent of the curves; if the dorsal and lumbar curves

are nearly equal, then the true waist on the right side becomes more marked than usual, corresponding to the lumbar concavity, and in advanced cases a distinct sulcus may be present between the lower ribs and the crest of the ilium. On the left side the hip appears to project ('growing out'), owing to the deflection of the trunk towards the right side, whilst the dorsal concavity higher up may simulate a false waist. In addition to the above phenomena, the buttocks may be noticed to be asymmetrical, if the scoliosis is of statical origin. The erector spinæ muscle stands out unduly on the left owing to the rotation of the vertebræ, whilst the transverse processes on this side may be unusually evident.

FIG. 122.—SECTION OF THORAX IN SCOLIOSIS. (AFTER HOLMES AND HULKE.)

In the early stages the characteristic deformity disappears on extension of the trunk, as by hanging from a trapeze, or on bending forwards; but as it progresses, the spine becomes more and more fixed, and but little alteration is produced by suspension of the patient. In the worst cases the deformity becomes so marked as to simulate the 'hump' formed in Pott's disease, especially when associated with kyphosis, and the patient's stature becomes dwarfed and stunted.

Subjective symptoms, such as neuralgic pain and weakness, are also present, but usually they are not very prominent features.

Anatomical Changes.—The structure of the spinal column is at first not manifestly altered, but as soon as the deformity becomes chronic, the individual vertebræ become misshapen. The bodies are somewhat wedge-like on section, being thicker on the convex than on the concave side. The *intervertebral discs* are similarly changed, whilst the *articular processes* are unduly pressed together on the concave side, and separated from one another on the convex. The transverse and spinous processes are also approximated to one another on the side of the concavity, and often curved. The *ligaments*, which in the early stages are relaxed, become secondarily shortened on the concave side, and may indeed disappear, the bodies of the vertebræ being ankylosed. The *muscles* are also relaxed in the early stages but accommodate themselves afterwards to the altered curves of the spine, and hence are contracted on the concave side and stretched on the convex.

It is most essential that a correct **Diagnosis** be made as soon as possible, since so much depends upon early treatment. A thorough

examination should be made with the clothes stripped to below the waist, so that the whole back can be seen. The patient should be made to sit straight up on a stool or chair placed sideways, and the surgeon stands behind her. The general appearance is first noted, and then the spinous processes are marked out one after another with a spot of ink or with a flesh pencil. The shape of the thorax, the curvature of the ribs, and the position of the scapulæ, are also ascertained. The patient is then made to stand, to hang from a bar, and to bend forwards, and the effects of these respective movements noted; by this means some idea can be obtained of the extent and nature of the deformity. There can be but little risk of mistaking it for Pott's disease, since the rigidity, deformity, and localized pain of the latter are so characteristic; in those cases of scoliosis, however, where there is a projection of the spinous processes backwards, a mistake might easily arise if only a careless examination were made.

The **Prognosis** necessarily varies with the stage which the affection has reached. In early days, before the deformity has become set, and when it disappears on extension of the spine, it is almost certain to be entirely cured, if suitable precautions are taken. Later on it can be improved to some extent, but in bad cases all that can be expected is to prevent it from getting worse.

In the **Treatment** of scoliosis, the cause of the trouble must not be overlooked, since in many cases the deformity may be remedied, or at any rate prevented from increasing, by attending to this. Thus, inequality in the length of the limbs necessitates the wearing of a high-heeled boot, whilst contractions of the knee- or hip-joints should, if possible, be remedied. In that variety which occurs in young people from constitutional or local debility, the general health must be improved by a visit to the seaside, or the administration of tonics, such as iron and arsenic. Carefully-regulated rest and exercise must also be recommended, so as to improve the muscular tone of the back without unduly fatiguing the patient; for a similar reason massage and cold baths are beneficial. All errors of position must be corrected, and suitable desks, forms, and chairs utilized. In the slighter cases it often suffices to order the patient to rest in the supine position on an inclined board for an hour or two daily, the head being thus raised and the spine extended. Calisthenic movements and gymnastic exercises, especially on the horizontal bar and trapeze, are also valuable. Of course, these must be arranged so as to exercise the weak muscles and counteract the deformity. Space forbids us describing them here, and we must refer readers to special textbooks. A spinal support is often useful, but should not be worn continuously, except in bad cases, as it renders the muscles of the back weak from disuse. All that is needed in the early stages is the support of a firm, carefully-fitted corset; but should the deformity increase, stronger steel instruments may be employed in which springs are incorporated, whereby it is hoped that correction of the curvature may be brought about. In the more severe cases, which are often associated with considerable pain, such a contrivance with axillary

crutches is absolutely essential. Plaster of Paris, applied according to Sayre's method, is certainly objectionable, since it is irremoveable and all other local treatment to the back is thus prevented.

Kyphosis.—By this term is meant a condition of increased dorsal convexity of the back (Fig. 123), which is often associated with loss of the lumbar concavity, so that the whole spine is arched backwards. Occasionally, however, a marked lumbar lordosis is present as a compensatory condition.

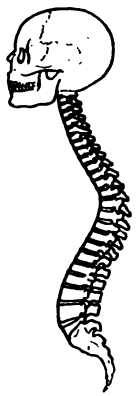


FIG. 123.—KYPHOSIS.

The chief **varieties** of kyphosis are as follows:

1. Kyphosis from defective growth or habit. This may occur (*a*) in children under the age of four, resulting from rickets; (*b*) in adolescents up to the age of sixteen (round shoulders), from a continuous habit of stooping, as in reading or writing, especially in those suffering from myopia; (*c*) various forms of occupation, which involve the carrying of heavy weights, or stooping over work, lead to its appearance in adults, as in porters and cobblers; (*d*) in old men it results from senile atrophy.

2. Kyphosis from general diseases of the spine is a marked feature in osteo-arthritis, osteitis deformans, osteo-malacia, hypertrophic osteo-arthropathy, and acromegaly. In the latter disease the condition is limited to the dorsal region.

3. Kyphosis from localized disease of the spine is sometimes described, although it is more commonly known by the contradictory term 'angular curvature.' It results from fractures, Pott's disease, gumma, or cancer (*q.v.*).

Treatment is impossible in the majority of cases, but the round shoulders of young people come so commonly under observation that a little more notice of the condition is needed.

Round Shoulders occur most frequently in girls who have grown rapidly, and perhaps developed precociously. The condition is often due to defective habits of sitting and standing, especially at school, and may be induced by faulty desks and chairs, whilst other intrinsic conditions, such as myopia or adenoids, may also be primarily responsible. The spine becomes bent forwards in the cervico-dorsal region; at first the deformity can be voluntarily corrected, but not so later on.

Treatment.—In the first place the cause must be ascertained, and if possible, removed; in particular, chairs and desks must be arranged so as to insure that the child sits in a good position. The essential point in the treatment is to increase the power of the muscles of the back, especially the trapezii, the erectores spinæ, the rhomboidei, and the serrati. This may be accomplished by massage, electricity, and exercises, the latter necessarily directed towards extension of the back. The girl should never be allowed to fatigue herself unduly, and must rest on her back two or three times a day for half an hour. At night she should lie on her back, without a bolster, and with a pillow beneath the curve. The general nutrition and health must also

be attended to, and a course of suitable tonics prescribed. In bad cases where the deformity is marked and it is feared it may be progressive, a light support may be required; a Chance's splint* will do as well as any, but of course the exercises must be persisted in.

Lordosis (Fig. 124) consists in an increased anterior curvature of the spine in the lumbar region. It is usually produced by continued flexion of the hip, whether due to congenital displacement, to unreduced dislocation, or to hip disease, and in such cases it is irremediable unless the malposition of the femur can be corrected.

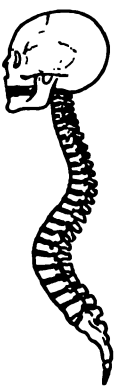


Fig. 124. Lordosis.

It is seen as a temporary condition in pregnancy, and as a more constant phenomenon in bad cases of uterine fibroids, owing to the increased weight of the uterus or its contents, necessitating backward displacement of the upper part of the spine in order to adjust correctly the centre of gravity of the body. The same may be noticed in persons with large, fat, and pendulous abdomens.

It is occasionally present in progressive muscular atrophy where the lumbar and abdominal muscles are weakened, and usually in pseudo-hypertrophic paralysis from loss of power in the gastrocnemii and other muscles engaged in maintaining the erect posture. In both cases the centre of gravity of the body is displaced forwards, necessitating the throwing backwards of the head and shoulders in order to maintain the equilibrium.

Spondylo-listhesis is the term applied to a curious and somewhat uncommon deformity, in which the lumbar vertebræ slip forwards and downwards from the top of the sacrum. It arises from fracture of the articular processes of the lumbo-sacral synchondrosis, or from imperfect development of the laminæ or pedicles of the lowest lumbar vertebra, as a result of which the pressure of loads carried on the shoulders or the weight of a pregnant uterus brings about the displacement. In the latter instance the enforced lordosis aggravates this tendency. The effects produced are shortening of the stature, together with the formation of a marked hollow above the sacrum, whilst the lumbar vertebræ are unduly prominent anteriorly. The condition is accompanied by neuralgic pain and weakness. The only *treatment* is prolonged rest in the recumbent posture, and possibly the application of a leather jacket, moulded to the pelvis, and supplied with crutches, so as to carry part of the weight downwards from the axillæ to the pelvic support without utilizing the spine.

* Many modifications of Chance's original splint have appeared, but the essential features of all are the presence of a metal pelvic band, from which rises a single or double bar of malleable iron, fitted to the back, and capable of having its curve altered. Lateral supports spring from the central bars or bar, and straps to fix it in position are also provided.

Deformities of the Upper Extremity.

Congenital Elevation of the Scapula (Sprengel's Shoulder) is a c
dition to which some attention has been recently attracted. T
scapula may be normal in size or a little smaller than usual, bu
situated above its proper position, thereby causing some deform
and is generally rotated so that its lower angle is approximated to
middle line. The muscles attached to its upper border are pro
nent; in a few instances an osseous band has replaced them, pass
between the upper angle of the bone and the seventh cervical ver
bra. The lower third of the trapezius is often defective, as also
serratus magnus. The amount of disability, which is usually slig
depends on the condition of these muscles, but the affected arm
sometimes smaller than its fellow. A slight degree of scolio
develops as a compensatory phenomenon. The condition is suppo
to result from abnormal intra-uterine pressure in the same way
congenital torticollis and talipes. The only treatment consists
dealing with the affected muscles by operation, if necessary. Th
deformity is distinguished from the 'growing-out shoulder' of ordin
scoliosis by the muscular defects, by the slightness of the scolio
curve, and by the congenital origin of the lesion.

Various types of **Club-hand** occur, in which the hand is deflected
one or the other side, or is hyper-extended or flexed. Perhaps t
most frequent cause is a *congenital absence of the radius*, under wh
circumstances the hand is radially abducted to a marked degree, t
ulna is shortened and curved, and its lower epiphysis much altered
shape and expanded, so as to articulate with the carpal bones. Wh
the bones are normal, the hand is usually flexed and adducted towa
the ulnar side. In any of these deformities skiagraphy should be e
ployed, so as to ascertain the exact relation of the bones to each oth

Congenital Deformities of the Finger are much more common, a
the account here given of such defects of the upper extremity appl
with equal force to those which occur in the lower. The followi
varieties may be alluded to:

Polydactylism consists in the presency of supernumerary fing
and toes. There may be from one to seven additional digits, and t
condition is usually symmetrical. One case is on record with twe
and thirteen fingers on the hands, and twelve toes on each foot. T
accessory digits are often stunted, and smaller in size than the norm
but may be of average dimensions. Usually they are separated fr
the true digits, but now and then may be blended with them. T
correct number of metacarpal and metatarsal bones may be pres
or they also may be multiplied. In one of our cases there were
digits and six metatarsal bones; but the last two digits were s
ported by an accessory metatarsal apparently springing from
outer side of the fourth. The condition is frequently inherited.

Treatment consists in removing the supernumerary digits, if usel
obtrusive, or troublesome. Sometimes the patients are proud of th
abnormality, and refuse to part with it. A patient with two w

thumbs may sometimes be benefited by uniting them laterally into a single broad one.

Ectrodactylism, or the absence of one or more of the digits, is occasionally seen, as also partial arrests of development of fingers or toes, or intra-uterine amputations at a higher level.

Macrodactyly (Fig. 125) consists in a congenital overgrowth of one or more fingers or toes. The structures are perfectly normal in character, and merely gigantic in size for the age of the individual.

FIG. 125.—MACRODACTYLY AND SYNDACTYLY.

In this case a child, aged two and a half years, had the ring and middle fingers united laterally into a large mass which projected far beyond the others. The middle finger was normal in size, the ring finger was hypertrophic. A fruitless attempt was made to save the middle finger, but both had finally to be amputated.

Amputation may be needed in these cases, as the deformed parts grow out of all proportion to the neighbouring tissues. Thus, an infant with enormous overgrowth of the second toe of the right foot was successfully treated by excision of the digit, together with a V-shaped portion of the foot, which was by this means reduced to normal shape and size.

Syndactylism, or webbed fingers, is a condition in which two or more

fingers are joined together laterally, either by a thin web consisting mainly of skin, or by a thick fleshy bond of union. In the foot no *treatment* is required, but in the hand the fingers must be separated. If there is merely a thin web, this may be divided by scissors; but to prevent its re-formation from above downwards, as healing proceeds, a flap of skin must be transplanted into the angle between the fingers, or an opening in the base of the web may be made and maintained, and the edges allowed to cicatrize before the web itself is divided. Where the union, however, is thick and fleshy, a more extensive operation is needed. Two flaps of skin as long as the web, and half the width of a finger, are respectively raised from the dorsal aspect of one finger and from the palmar aspect of the other, in such a manner that, after the web has been divided, the denuded surfaces can be covered by wrapping the flaps round the lateral aspects of the fingers and suturing them in position. An additional flap of skin must also be fixed in the angle between the separated digits, unless the preliminary measure just described has been undertaken.

Congenital Contraction of the Fingers is not a very rare deformity; it is frequently inherited, and usually limited to the little finger; it may be associated with congenital hammer-toe. It is due to contraction of the *central* prolongation of the palmar fascia in the finger, whereas in Dupuytren's contraction it is the palmar fascia itself and its *lateral* prolongations into the fingers that are involved. Moreover, the character of the deformity differs; in the congenital variety the first phalanx is hyper-extended, and the second and third flexed, whereas in the acquired form the first and second phalanges are flexed and the third is hyper-extended. **Treatment.**—It often suffices to use massage and apply a splint, but in bad cases division of the fascial bands may be needed.

Acquired Deformities of the Hand.—After burns the hand may be contracted into a useless mass in which the fingers are drawn into the palm and united by cicatricial tissue to the palmar structures, so that all treatment is hopeless.

Spring-, Jerk-, or Snap-Finger is a curious condition in which, when the patient attempts to open his hand, one finger or the thumb remains flexed, and on extending it with the other hand it flies open with a jerk or snap. Some slight tenderness and pain is usually felt near the metacarpo-phalangeal articulation, and the cause of the trouble is some obstruction to the free working of the long tendons under the transverse ligament at the root of the fingers, or between the sesamoid bones in the case of the thumb. In a few cases a ganglion has been present here, but in most instances it is due to an increase in size of the sesamoid bone which the X rays have taught us constantly occurs in this situation. Treatment consists in an aseptic incision to remove the cause of the obstruction.

A **Mallet Finger** is one in which the terminal phalanx is maintained in a state of flexion owing to some damage to the extensor aponeurosis. It usually follows injuries, which lead either to a separation of the tendon from the bone, or to a thinning of its texture, whereby the

flexor tendon is able to act with undue power. The **Treatment** consists in the application of an anterior finger-splint in the early stages, but later on, should the deformity be persistent, an incision is made on the posterior aspect of the joint, and the weak tendon isolated and stitched down in such a way as to give it a better attachment to the bone.

Contraction of the Palmar Fascia (Dupuytren's Contraction).—This condition is usually met with in middle-aged individuals of a gouty temperament, more often in men than women, and not unfrequently on both sides of the body. It may or may not be associated with direct irritation of the palm, as by leaning much on a round-headed cane, or from the constant use of some instrument, such as an awl, whilst heredity is an important causative factor. Pathologically, it is due to a chronic overgrowth and contraction of the fascia, inflammatory in nature, and cirrhotic or sclerosing in type. It commences

FIG. 126. DUPUYTREN'S CONTRACTION. (FROM A PHOTOGRAPH.)

as an indurated subcutaneous nodule in the palm of the hand, about the situation of the most marked transverse crease, and affects most commonly the ring and little fingers first, the other fingers and thumb being less often involved. The induration spreads slowly both up and down the fascial bands into the fingers, which, as it increases, are gradually drawn into the palm and fixed, so that extension becomes impossible (Fig. 126). The flexion is limited to the first and second phalanges, the third remaining extended, and, indeed, sometimes assuming a position of hyper-extension, owing to the injudicious application of a splint. The skin over the indurated masses is sooner or later incorporated with them, and may become dimpled or creased by the traction of the subcutaneous connecting bands.

The **Diagnosis** of Dupuytren's contraction is exceedingly easy, the only condition for which it is likely to be mistaken being the congenital contraction already noted, and flexion of the finger due to contraction of the long tendons. In the latter case there is, as a rule, no palmar

induration, and on attempting to straighten the finger the tendons may be felt to become tense above the wrist; the terminal phalanx is also flexed in many instances.

The only satisfactory **Treatment** is by operation, and the following methods are those which are most successful: (*a*) Adams' subcutaneous section of the fascia and its prolongations consists in dividing the indurated bands by a tenotome in several places, where they can be felt tense. One puncture and division must be made in the centre of the palm; a second divides the same band as near the finger as possible, whilst the third and fourth deal with the lateral prolongations at the sides of the finger; if other bands still exist, they are treated similarly, the tenotome, if possible, in all cases being inserted between the skin and the fascia. The improvement thus produced must be maintained and increased by the subsequent use of suitable apparatus and passive movements, but the final results are not very satisfactory. (*b*) Kocher's method consists in the total extirpation of the thickened bands and their prolongations through longitudinal incisions. The fingers are at once straightened, and subsequent contraction is prevented by mechanical appliances. We have had many excellent and lasting cures by the latter operation.

FIG. 127.—COXA VARA.
The dotted lines represent the normal neck of the femur.

Deformities of the Lower Extremity.

Coxa Vara, or incurvation of the neck of the femur (Fig. 127), is a condition to which attention has been called only of recent years. The neck of the bone, instead of passing obliquely upwards, is horizontal, or in bad cases directed downwards and usually backwards, whilst shortening from interstitial absorption also occurs, and the head becomes mushroom-shaped (Plate V.). At first the osseous tissue is softened, but after a while sclerosis supervenes. It is met with in young children as a result of rickets, or perhaps more frequently in adolescents, when it is sometimes supposed to be a late manifestation of the same disease. Certainly it is seen most frequently in those who have to do much walking or carrying of heavy weights. In some cases it results from a gradual slipping down of the epiphysis, which constitutes the head of the bone, or from a fracture of the neck in a child, followed by yielding of the callus.

The **Symptoms** commence with pain in the region of the hip, followed by a distinct limp. As the neck of the bone becomes absorbed or curved, the trochanter rises above Nélaton's line, and real shortening

PLATE V.

SKIAGRAM OF DOUBLE COXA VARA

ıb occurs, even up to 1½ inches. The limb is also everted trochanter increasingly prominent, especially on flexing the The movements of the joint are limited, particularly in the of internal rotation and abduction, the latter being practically e in the more severe cases, owing to the base of the trochanter against the lip of the aceta-

On flexing the limb, the thigh s lies across the sound one, the later stages the adduction o marked that a scissor-legged occurs if both sides are affected. guishing features may be men- ıe absence of local swelling or s on pressure, as also of the up- movement on traction, so well n congenital dislocation, whilst on never follows, and thickening chanter is not observed.

FIG. 128.—GENU VALGUM OF RACHITIC ORIGIN.

The patient was a child aged twelve years, and the cause of the deformity was rickets. The femora were curved antero-posteriorly, but skiagraphy demonstrated that the trouble in the right leg was as much tibial as femoral in origin. Cuneiform osteotomy of both tibia and femur was needed on the right side, whilst simple osteotomy of the femur sufficed to correct the left side.

ent.—In the early stages rest is ial, and thereby any increase in mity already existing is pre- ocal massage and manipulation advisable, whilst in children l extension may do good. In stages, subtrochanteric oste- order to alter the axis of the perhaps the best measure to ; although a cuneiform oste- the neck is recommended by he subsequent shortening may with by means of a thick sole der surface of the boot.

algum, or *knock-knee*, is a de- ı which, if the knees are allowed with the patellæ looking for- ıe malleoli are separated one other—*i.e.*, it is a fixed con- abduction of the legs from the ıe, with some external rotation). One or both limbs may be but if due to general causes ɔle form is more common. ally genu valgum occurs in one t the other is in a condition of ım.

are two main **varieties** of the disease, viz.: (1) The rachitic ɣum of young children, and (2) the static form occurring in ıts.

ı *valgum of young children* is practically always due to *rickets*

owing to the irregular epiphyseal development induced thereby. some cases there is a primary increased growth on the inner side; others, an arrest of development on the outer; in the majority, b conditions are probably present. The location of the mischief, whet mainly femoral or tibial, also varies in different cases, but the femo type is more common than the tibial. In some an antero-lateral rachi curvature of the diaphysis of the femur is an important eleme especially when the child has been allowed to walk or run about t early.

The genu valgum of adolescents, or static genu valgum, occurs m commonly in young people under twenty, of relaxed constitution, a particularly in those who, in addition, have to carry heavy weigh Thus, anæmic young women who act as nursemaids, and young bri layers, smiths, and porters, are very liable to it. The method of ori is probably as follows: In the erect posture the femur is normally se an angle to the tibia (which is vertical) in such a way that the wei of the trunk, transmitted in a vertical line from the head of the fem to the ground, passes rather through the outer than the inner condy whilst the latter structure is lengthened in order to keep the plane the knee-joint horizontal. This position naturally throws a cert amount of strain and tension on the internal lateral ligament, even a healthy person (hence its insertion into the shaft and not merely i the upper epiphysis of the tibia); and this strain is increased when natural position of rest—*i.e.*, with the feet separated and sligh abducted—is adopted. A long continuance of this posture tires th muscles on the inner side of the limb which tend to counterbala this strain, especially if a certain amount of additional weight has be carried, and particularly in those whose bones have rapidly increa in length and weight without any coincident increase in power muscles or ligaments. Hence the internal lateral ligament becom more and more stretched, and not unfrequently a certain amount lateral mobility of the knee is noticed in the early stages. Subsequ the outer condyle becomes atrophied from more weight being tra mitted through it, and the inner condyle becomes lengthened fr overgrowth. It is also important to note that flat-foot and late curvature of the spine often accompany this form of genu valgum, former being also usually due to ligamentous relaxation, whilst latter may be merely associated with it, or be compensatory if deformity in the knee is unilateral.

Occasionally genu valgum is due to *traumatic causes*, such as fract of the tibia or femur close to the joint, or lateral dislocation of knee; whilst, again, it may be caused by atrophy consequent on in ference with the epiphysis from local injury or diseases other th rickets. It is sometimes observed, as a result of riding, in those w long legs, as in cavalry soldiers; short-legged individuals, such jockeys, are more liable to develop a condition of genu varum.

The **Physical Condition** of the parts about the knee may be summ ized as follows:

(*a*) The inner condyle of the femur forms a marked and obvi

subcutaneous projection; the increase in size is mainly in the vertical and transverse directions, and but very little antero-posteriorly, so that, on flexion of the joint, the deformity to a large extent disappears.

(b) In rachitic cases a localized bony outgrowth can usually be detected on the inner surface of the tibia about 2 or 3 inches from the joint, and probably due to a localized periostitis at the point of attachment of the internal lateral ligament.

(c) Impaired growth and atrophy is observed in the outer femoral condyle and tibial tuberosity, conditions supposed to be due to the weight of the body being transmitted more directly through these structures.

(d) Relaxation of the ligamentous and muscular tissues takes place on the inner side of the joint. This, however, is not constant, especially in the later stages, or in cases which are stationary.

(e) The tendons and ligaments on the outer aspect of the joint are contracted and shortened, especially the external lateral ligament, the ilio-tibial band, and the tendon of the biceps.

(*f*) The patella tends to be thrown outwards from the angular deformity existing at the knee-joint. Occasionally the bone is actually dislocated, and when this has once happened the displacement is very likely to recur from time to time.

The following conditions are also observed not unfrequently, viz.: The feet are displaced outwards, or occasionally inwards, as best suits the convenience of the patient in obtaining as good a footing as possible; the bones of the legs and of the thighs are often bent; whilst, if unilateral, the pelvis is tilted downwards on the affected side, and the spine laterally curved.

In well-marked cases the gait of the patient is of a rolling or waddling type, and very characteristic. The legs are partially flexed, and as the condyles touch or overlap, they have to be separated at each step to allow of progression. Occasionally bursæ form over the points where the friction is most marked.

Treatment.—In *rachitic* infants, the general condition must be dealt with in accordance with the rules given elsewhere (p. 601). A suitable diet should be ordered, cleanliness attended to, and plenty of fresh air allowed. Parrish's food is perhaps the best drug to administer, whilst cod-liver oil is rarely needed, since it increases the body-weight, and so may do harm rather than good. Absolute rest in bed is enforced; the limbs are well rubbed daily, and such manipulation and pressure employed as will help to straighten the limb. By perseverance slow but appreciable progress may be made until the deformity is corrected. In older children, splints may be applied on the outer side of the limbs, reaching from the pelvis down to the outer malleoli, or, if they are to be kept off their feet, beyond them. These are retained in position by water-glass bandages, put on firmly enough to draw the knees outwards. Such an arrangement is often sufficient in early cases to bring about a cure in the course of a few months. Some authorities have recommended forcible correction of the deformity, and subsequent fixation in plaster of Paris, but the condition of the

epiphyses, and the ease with which they are detached, are good reasons against adopting any such method.

In the *static* cases the administration of tonics, such as iron and arsenic, combined with rest, massage, and possibly a change of air, will frequently suffice to determine a cure in the early stages.

When the deformity is somewhat more advanced, more complicated apparatus is needed; that usually employed consists of an outside iron stem, jointed at the knee, fixed below into a slot in the heel of a well-made boot, and attached above to a pelvic band. From it several well-padded straps pass round the limb, and at the knee itself a much broader one covers the projecting inner condyle; by tightening these, the limb is drawn out towards the rod. The apparatus is somewhat heavy, but if carefully applied for some months may effect a cure. It is possible that division of the tense structures on the outer side of the joint may considerably assist the process.

When, however, the osseous deformity is marked, and the patient of such an age as to preclude the hope of a cure by mechanical means, *osteotomy* will be required, and the operation devised by *Macewen*, or some modification of it, is that generally employed. It consists in the division of the femur transversely about a finger's breadth above the upper border of the external condyle, so as to be well away from the epiphyseal cartilage. Macewen himself uses an osteotome* for the purpose, introducing it through an incision made ½ inch in front of the tendon of the adductor magnus, and turning it so as to lie at right angles to the long axis of the shaft; he divides the bone for three-quarters of its diameter, and breaks the remainder. A similar method may be employed from the outer side, the force used in breaking the inner layer of compact bone comminuting and compressing that portion, and so diminishing the deformity. Many surgeons, however, prefer to divide the bone with a saw, previously making a track for it along the front of the femur, and we certainly consider that such an operation is simpler, and equally efficacious. The limb, having been straightened, is either put up at once in plaster of Paris, or, perhaps, at first in a Gooch's splint, which allows the wound to be looked at and dressed, and subsequently in plaster. Union is complete in six weeks, but an immoveable apparatus should be kept on for three months.

In a few cases due to rickets it may be necessary to divide the tibia just below the tubercle in addition to dealing with the femur. This is best accomplished as a first step, and the fibula will also have to be divided. When these wounds have consolidated, the femur is dealt with, if necessary.

Genu Varum, or *bow-leg*, is a less common condition, the exact opposite of genu valgum, and what has been said above of the one is true of the other, if the word 'internal' be substituted for 'external' and *vice versâ*. Treatment is only required in bad cases.

Genu Recurvatum, or *back-knee*, is a deformity occasionally met with in which the joint is hyper-extended, the limb describing a curve with

* An *osteotome* differs from a *chisel* in the fact that the former is bevelled on both sides, whilst the latter is merely bevelled on one side.

to the special requirements of the individual case.

tions of the Knee may arise from intra- or extra-articular The *extra-articular* causes may be situated (1) in the *skin* and ous tissues, as a result of the contraction of cicatrices of ulcers; or (2) in the flexor *muscles*, which may become con- consequence of diffuse suppuration within their sheaths, or le paralysis of the extensors, or as a secondary result of tory troubles in the knee-joint. (3) The contraction is in es *hysterical*, the joint being fixed by muscular action, but ; healthy, although much pain and superficial tenderness are ed of. The diagnosis is readily made by inducing anæsthesia, the patient unawares, when the limb is found freely moveable e easily straightened.

ticular causes are as follows: (1) Where the capsule and are mainly affected, the causative inflammation having been matic or gonorrhœal nature. The limb is fixed, but there is displacement of the tibia. (2) Fibrous adhesions of greater ensity may pass between the articular surfaces, as a result acute synovitis or of tuberculous or acute arthritis. In the se some mobility may be present, but in the latter the move- ay be very defective. (3) Osseous ankylosis may follow us or acute arthritis, the position of the limb depending on ous treatment. Thus, in neglected cases the tibia is occa- lexed on the femur, whilst its upper surface is displaced lly backwards, and the lower limb rotated outwards, consti- at is known as the *triple displacement*. If the limb has been o lie on its outer side whilst disorganization was proceeding, y be an additional outward displacement of the tibia. (4) rtial excision in early life, the knee may become flexed or tended years later, as a result of irregular growth at the l line. Flexion is much more common than extension.

reatment of these conditions necessarily depends on their

Rachitic Tibia and Fibula.—These bones are liable to a considerable amount of distortion in the course of an attack of rickets if the child is allowed to run about. As a rule, the antero-posterior curve is increased, and some amount of ab- or ad-duction may also be present (Fig. 599). The bones, too, are usually flattened from side to side, presenting a sharp edge in front, with a buttress-like support reaching along the concavity; they become exceedingly dense and sclerosed. Operations should never be undertaken until all active signs of rickets have disappeared. The bones may simply be divided at their most prominent part, or, if necessary, a wedge-shaped portion may be removed from the tibia (*cuneiform osteotomy*), the sections being made at right angles to the upper and lower segments of the bone respectively. The fibula never needs more than simple division, and this is accomplished through a separate incision.

The tibia and fibula also become distorted and curved antero-posteriorly as the result of *inherited syphilis*. The deformity in this case is purely antero-posterior, without lateral deviation, whilst the subcutaneous margin of the tibia is rounded, and not sharp as in rickets. Moreover, the curve is mainly placed in the centre of the shaft, whilst in rickets the chief deformity occurs either near the knee or a little above the ankle. There should, therefore, be but little difficulty in distinguishing these two conditions, and the previous history of the case may materially assist in forming a correct diagnosis.

Talipes.

By talipes, or club-foot, is meant a deformity of the foot due to muscular, ligamentous, or osseous causes, the displacement occurring mainly at the ankle and mid-tarsal joints.

Causes.—Talipes may be congenital or acquired.

Congenital malformation or malposition is responsible for a certain percentage of the cases. Such may result from imperfect development of the bones of the foot or leg, or from intra-uterine paralysis of central origin. Other cases may be due to a deficient amount of liquor amnii, as a result of which the feet are abnormally compressed and held in one position. It must be remembered in this connection that in the fœtus the legs are naturally in a state of flexion, and the feet usually in the position corresponding to that of talipes varus; it is easy then to understand that in an unusually small uterus this tendency may be exaggerated. Spina bifida in the lumbar region is occasionally associated with congenital talipes, which is then probably due to impairment of nervous control. The congenital variety is often hereditary, and may occur in several members of the same family, or be transmitted through many generations.

The *acquired* varieties are somewhat easier to understand than the congenital, since they frequently arise from some derangement of the equilibrium normally maintained between opposing groups of muscles, in consequence of which the most powerful group draws the foot into an abnormal position. Thus it may be due to: (*a*) Paralysis

gin, one of the commonest causes of talipes; in young
is form is usually the result of infantile palsy (anterior
tis), whilst a similar affection is occasionally seen in adults.
ction of muscles, from diffuse suppuration, arising from
isease of neighbouring bones; thus necrosis or caries of
ay lead to the formation of an abscess in the sheaths of the
icus or posticus, and contraction of one or both of these
ıy cause talipes varus. (*c*) Essential muscular shrinking,
om a chronic myositis fibrosa, is occasionally met with in
ple. (*d*) Affections of the main peripheral nerve-trunks of
lead to talipes. If the internal popliteal nerve is involved,
aneo-valgus will ensue, whilst a lesion of the external

B C

FIG. 129.—VARIOUS FORMS OF TALIPES EQUINUS.

erve produces talipes equino-varus, but never to any marked
e) Deep spinal mischief of a sclerosing type occasionally
ism of some group of muscles and talipes of a spastic type.
ening of the leg from hip or knee mischief often induces a
ory talipes equinus, whilst injuries or diseases of one of the
of the leg bones may stop its growth, and then the continued
nt of the other bone forces the foot to one side or the other.
question whether the condition known as flat-foot, arising
nged standing, is to be classed as a form of talipes; some
lraw but little difference between it and talipes valgus.
', prolonged maintenance of the foot in a bad position may
manent deformity, as in the variety known as talipes decu-
e barbarous custom still practised by the Chinese of forcibly
g the feet of female children brings about a similar result.
.—In considering the different forms of club-foot, it must
ered that the ankle is a hinge joint only allowing of flexion
sion, although when fully plantar-flexed a little lateral

mobility is also possible. The movements of abduction and adduction of the foot take place at the subastragaloid and mid-tarsal articulations. Four primary varieties of talipes are hence described, viz.: **T. Equinus**, in which the heel is drawn up, the patient walking on the toes (plantar-flexion); **T. Calcaneus**, in which the toes are raised from the ground (dorsi-flexion); **T. Varus**, in which the anterior half of the foot is adducted, and the inner side of the foot is raised, the patient walking on the outer; and **T. Valgus**, due to abduction and eversion of the anterior half of the foot, or to yielding of the longitudinal arch on the inner side. Not unfrequently mixed forms occur, due to the association of two of the above, *e.g.*, T. equino-varus, or T. equino-valgus, or T. calcaneo-valgus.

FIG. 130.—CONGENITAL TALIPES VARUS.

FIG. 131.—PARALYTIC FORM OF TALIPES EQUINO-VARUS.

As to the *relative frequency* of these different forms, there is not the slightest question that T. equino-varus is by far the commonest. If, however, we exclude congenital cases and flat-foot, T. equinus is in all probability the variety most frequently observed.

Talipes Equinus (Fig. 129, A, B, and C) is almost always acquired; as a congenital lesion it is very uncommon. It is usually due to paralysis of the extensor muscles, either from infantile palsy or injury to the anterior tibial nerve; secondary contraction of the calf muscles follows, the tendo Achillis being tense and rigid. It also occurs as a compensatory manifestation where the limb has been shortened, as after hip disease, and a variety known as T. decubitus results from prolonged pressure of the bed-clothes on the dorsum of the foot of a bed-ridden patient.

In the slightest cases all that is noticed is that the foot cannot be dorsi-flexed beyond a right angle (right-angled contraction of the ankle). When more marked, the heel is drawn up, and the patient walks on the heads of the metatarsal bones and on the toes, which are usually hyper-extended. In neglected cases due to paralysis, the toes sometimes become flexed, the patient walking on their upper surface

y, C); the whole dorsum of the foot may even in time be
lownwards. The astragalus is displaced forwards from under
leolar arch, only the posterior part of the articular surface
contact with the tibia. In the paralytic type the anterior
of the foot drops at the mid-tarsal joint, so that the head of
galus and scaphoid constitute a marked prominence beneath
. In all cases the sole of the foot is shortened by contraction
antar fascia and of the short plantar muscles (pes cavus), and
amount of varus is frequently present. In this, as in all
talipes, callosities, and perhaps bursæ beneath them, form over
pressure, viz., under the heads of *all* the metatarsal bones.
s **Varus**, or, as it is most frequently termed, **Equino-varus**, is

A B

FIG. 132.—NEGLECTED CASE OF TALIPES VARUS.

monest variety of congenital club-foot, but is not a very
result of infantile palsy of the extensor and peroneal muscles,
ondary shortening of the tibialis anticus and posticus, the
ngus digitorum, and of the tendo Achillis. Other cases are
primary spastic contraction of these muscles.
eel is drawn up, and the anterior half of the foot adducted
vn inwards (Fig. 130). The inner border of the foot is con-
d a well-marked transverse crease crosses the sole on a level
mid-tarsal joint; the outer border is convex, and in adults
e walked a thick bursal formation is usually present over the
In neglected cases the patient may even stand on the dorsal
f the latter bone (Fig. 132, A). The sole of the foot is arched
ondary contraction of the plantar fascia and short muscles of
, especially the abductor hallucis, and a longitudinal crease
down the centre of the sole, owing to doubling over of the
etatarsal bones (Fig. 132, B).
nost marked **Anatomical Changes** in the congenital type are
the astragalus. In infants the head and neck are normally
angle to the body of the bone, being directed slightly inwards;
th proceeds, this diminishes from about 35° to 10°, so that in
lt there is but little obliquity of the neck. In Talipes varus
gle is increased, often amounting to 50° or more, the neck at

the same time being longer than usual, a condition simulatin found in some of the higher apes. The bone also projects fo from under the tibio-fibular arch, the posterior portion of the articular facet alone remaining in contact with it. The scap displaced to the inner side of the head of the astragalus, a tubercle is usually in close proximity to, or may even touch, th malleolus. The os calcis and other tarsal bones are also modi position and shape to correspond with these changes. The tendons are displaced inwards, usually occupying the centre concavity between the foot and the leg. The ligaments on th side of the foot are contracted, especially the anterior portion deltoid, the inferior calcaneo-scaphoid, and to a less extent th and short plantar ligaments.

The following table (slightly modified from Mr. Tubby's w Deformities*) indicates the chief diagnostic points between con and paralytic T. equino-varus:

	CONGENITAL.	PARALYTIC.
HISTORY.....	Affection has existed from birth.	Affection not developed second or third ye ushered in by conv fever, etc.
FEET AFFECTED.....	Usually bilateral.	More often unilateral.
CIRCULATION.....	Good.	Feeble; limb is cold, b clammy.
MUSCLES.....	But little wasting.	Extreme wasting.
ELECTRICAL REACTIONS	Not much impaired.	Almost entirely absent lyzed muscles.
GROWTH OF BONES	Much as usual.	Considerably diminishe
FURROWS IN SOLE	Present.	Absent.

FIG. 133. — PARALYTIC TALIPES CALCANEUS.

Talipes Calcaneus (Fig. 133) is an e variety of the deformity, and may be congenital or acquired. In the co form the toes are drawn upwards a the heel alone comes into contact w ground, the sole pointing forwards extensor tendons are contracted, t toes may be flexed owing to the ten the flexor longus digitorum. It is times associated with deviation of t inwards or outwards, constituting dition of T. calcaneo-varus or - The *acquired* variety is generally infantile palsy of the calf muscl occasionally results from over-stretc the tendo Achillis after tenotomy longitudinal arch of the foot is inc partly from the development of a la of fat over the calcaneal tuberosities, but mainly from the t being drawn up towards the leg as in the preceding variety

* Macmillan, 1896, p. 398.

nterior half of the foot appears to drop forwards from the mid-tarsal int owing to secondary contraction of the plantar fascia and short uscles of the sole.

Talipes Valgus is a condition seldom met with as a *congenital* de- rmity, except in association with T. equinus. In it the outer side f the foot is abducted and everted, owing to contraction of the peronei uscles. The sole becomes flattened, and the inner border of the ot comes in contact with the ground (Fig. 134). Considerable pain usually experienced after walking a short distance. The scaphoid displaced outwards, so that the inner portion of the head of the stragalus projects into the sole of the foot, the cartilage being covered. This deformity is occasionally due to absence of the bula. The *acquired* variety, which is not uncommon (Fig. 135), is oduced as a result of paralysis of the tibial muscles, or from spastic

. 134.—TALIPES VALGUS (CONGENITAL), H A LITTLE TENDENCY TO CALCANEUS.

FIG. 135.—ACQUIRED TALIPES VALGUS.

traction of the peronei, the condition in these cases closely simu- ng flat-foot.

The **Diagnosis** of the different varieties of talipes is, as a rule, easily de, although the cause of the deformity is not always so readily ertained. In *paralytic* cases the limb is always atrophied, bluish colour, and feels cold and clammy. Trophic lesions are not un- mon in the shape of recurrent ulceration, and even ulcers of the forating type may develop, especially in cases due to nerve lesions, ther central or peripheral. The trouble is often unilateral, and muscles are wasted and flabby. In *congenital* cases the condition sually symmetrical, and of course present from birth; considerable stance is felt on any attempt being made to correct the deformity, the limbs are well nourished, at any rate at first. In *spastic* cases st frequently T. equinus) spasm or contraction of other parts is ally present, which renders the diagnosis obvious; one or both bs may be affected; the muscles, at first firmly contracted, may lly atrophy.

The **Treatment** of talipes is always tedious, demanding care and ence on the part of all concerned. In the congenital variety no e should be lost in correcting the deformity, and, in fact, treatment

should commence as soon after birth as possible. The nurse be instructed to manipulate the foot into a good position, hol there for some time daily, and the medical attendant may a more forcible correction two or three times a week. At th time the muscles on the offending side of the limb should be and stimulated. In the early stages of the paralytic variety f and faradization of the paralyzed muscles must be regularly taken. At a somewhat later date treatment by the applica suitable mechanical apparatus may suffice to restore the foo normal position. If this is unsuccessful, division of the cont tendons, ligaments, and fasciæ will be necessary, whilst in seve neglected cases more extensive operations in the shape of tars or tarsotomy may have to be performed.

Talipes equinus, if secondary to hip disease, should not, as a r interfered with. In other early cases, it may be remedied by is known as Sayre's ratus (Fig. 136). Th sists in the applicati plantar splint whic jects slightly beyon toes, and from the a end of which a piece hesive strapping is to just below the k which it is applie fixed by a firm ba Each day the band carried a little lowe the limb, and as the t of the strapping is i increased, the f gradually extended.

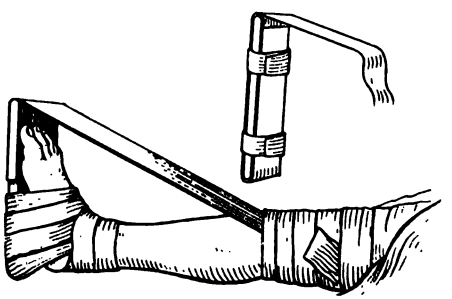


FIG. 136.—SAYRE'S APPARATUS FOR TALIPES EQUINUS.

The upper figure shows how the strapping is fixed to the plantar splint.

more serious varieties tenotomy of the tendo Achillis may be re accompanied, if necessary, by division of the plantar fascia, w neglected cases, or where tenotomy has failed, excision, astragalus gives most excellent results, the patient being able t subsequently with a plantigrade foot.

Talipes equino-varus may be treated in the early stages by a to the foot a carefully-fitted malleable splint (Fig. 137), the s which is gradually altered so as to bring it in time to a normal p or by a series of casings of plaster of Paris, a little improvemen obtained at each change. By care and patience many a cure w be obtained. In some cases the tendo Achillis may be divid the equinus element cured, thereby rendering the varus conditio amenable to pressure.

In cases where such early treatment has not been underta where the deformity has not been improved thereby, *forcible c (redressement modelant)* may be attempted. The child is placed an anæsthetic, and the foot is forcibly wrenched and moulde

ition, a Thomas's wrench being employed, if need be. It is that the foot should remain in good position when all force ed from it. Possibly division of the tibial tendons may assist ocedure, as also section of the tense ligaments on the inner ie foot (syndesmotomy), but if such can be avoided, so much r. The foot is then placed in plaster of Paris for five or six id subsequently massage and suitable exercises are employed lking is allowed.

lowever, only in the early stages that such treatment is . At the age of eighteen to twenty-four months considerable f the limb has deter- h osseous development forbids one to expect om it, since the force correct the deformity very great. Hence, if is not commenced till s two years of age, and if the child has walked r, other methods must yed. Of these, two ns have been advo- iz., tarsectomy and peration. 1. In *tar-* wedge-shaped portion is removed from the ect of the foot. This lished through a semi- cision on the outer the foot, a flap being so as to allow it to be l before the operation ted, so that the skin se may help to keep in good position. The thick subcutaneous structures, in- he bursa, are removed, and the extensor tendons, already t displaced inwards, are stripped from the bones by a , and held aside by retractors. The tarsus is now divided el in two places in such a way that a wedge of bone can ed, the base being on the outer aspect, and the apex on . The position of the joints need not be taken much into tion, and as far as possible the sections are made at right the anterior and posterior segments of the foot respec- As a rule, one removes the head of the astragalus and part reater process of the os calcis; sufficient bone must be o allow the foot to come into good position without diffi- he wound is then closed, and the foot placed in a good position, it is maintained at first by ordinary splints and subsequently of Paris for six or eight weeks. The results are excellent,

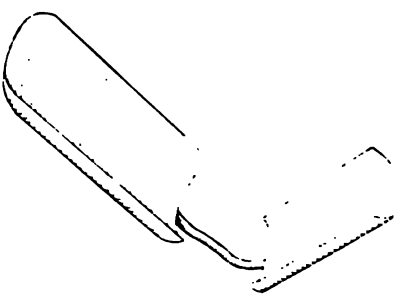


FIG. 137. — MALLEABLE SPLINT FOR TREATMENT OF CONGENITAL TALIPES EQUINO-VARUS.

It consists of two plates of metal, shaped to fit the sole of the foot and the lower part of the leg respectively; these are united by a malleable curved bar of copper. The foot-piece is first fixed, and then the foot brought into as good a position as possible, and the leg-piece bandaged on. Each week the foot-piece is bent a little more towards the normal position.

the foot, although a little shortened, being firm and plantigr
2. *Phelps' operation* consists in dividing all the structures on the i
aspect of the foot through a vertical incision, starting above jus
front of the internal malleolus. The mid-tarsal joint is usually ope
tendons and ligaments are divided, and the foot put up in a
position with the wound gaping. Healing may be accelerated
skin grafting. The results are at first quite as good as those attai
by tarsectomy, and the operation has the advantage of not shorte
the foot; but there is a decided tendency for the deformity to re
as cicatrization advances. In successful cases the longitudinal
of the foot is lost, and the cosmetic result is anything but perf
whilst the patient usually requires an instep support. In our opi
tarsectomy is much the better operation, and even when underta
in children need not interfere with the subsequent growth of the f

In *Talipes calcaneus* all that may be needed is division of the exte
tendons; but in the paralytic variety some form of apparatus m
always be worn. Where the tendo Achillis is thin and attenuate
portion of it may be excised, and the ends united by suture; or
healthy peroneus longus tendon may be grafted into the tendo Achi
or the tubercle of the os calcis into which the latter is inserted
be sawn off and re-attached by a nail or peg to the bone at a lo
level (Walsham); but the prognosis in all forms due to paralysi
somewhat unsatisfactory.

Talipes valgus, if unrelieved by the application of suitable bo
may need division of the peroneal tendons, or in severer cases wre
ing the foot into position, and fixation in plaster of Paris. Rem
of a wedge-shaped portion of bone from the inner aspect of the
may be undertaken, but is not very successful.

Flat-foot (*syn.:* **Splay-foot** or **Spurious Valgus**) is a condition
quently seen in young adults whose occupation exposes them to
standing, over-fatigue, or the carrying of heavy weights; hence
commonly met with in nurse-girls and shop-boys who have
recently left school, any general deterioration of the health
assisting in the production of the deformity. It occurs as a na
condition in many of the negro races, and is more often seen in
than in short feet. It also results from various osseous lesions
fracture of the neck of the astragalus, of the sustentaculum ta
of the greater process of the calcaneum (*traumatic flat-foot*).

Mechanism.—In the majority of cases it is due to relaxation o
inferior calcaneo-scaphoid ligament, which supports the under su
of the head of the astragalus, and thus keeps up the longitudinal
of the foot. This in its turn is braced up by the tendon of the ti
posticus and an expansion backwards therefrom to the os calc
also by the plantar fascia and ligaments, and by the short musc
the sole. A rapid increase in the length and weight of the sk
apart from an equivalent increase in strength of muscles and liga
throws undue strain upon this structure, especially if the pati
suddenly exposed to long hours of standing or weight-carrying.
ligament stretches, the head of the astragalus sinks, the an

ortion of the foot becomes abducted at the mid-tarsal joint, and he typical splay-foot results. The tibialis posticus is often relaxed r even paretic, and the peronei tendons are in the later stages con-acted. Occasionally the deformity is due to a gonorrhœal inflam-ation of the inferior calcaneo-scaphoid ligament, which becomes laxed and yields under the weight of the body. However produced, e *deformity* is tolerably characteristic (Fig. 138). The sole of the ot is flat, and in well-marked cases comes in contact with the ound throughout the whole of its extent. The inner border is ovex and somewhat lengthened, whilst there is a tendency to ever-n of its anterior portion: the outer border may be slightly raised om the ground. The head of the astragalus is distinctly felt a little

FIG. 138.—FLAT-FOOT.

front of and below the internal malleolus, whilst the sustentaculum , which is normally to be distinguished about ¾ inch below malleolus, is buried by this displacement. The tubercle of the phoid is less evident than usual, being situated below and in nt of the head of the astragalus. In the early stages the patient nplains of a sensation of fatigue or weakness along the inner side the foot or ankle, increased by exertion. Later on, the gait omes somewhat shuffling, and severe pain is experienced, not only he sole, but also on the dorsum over the astragalo-scaphoid joint. metimes it is extremely marked in the metatarso-phalangeal joint the great toe, which may be enlarged and inflamed, owing to an ociated chronic arthritis (*vide* Hallux rigidus).

Treatment.—In the earliest stages, when the deformity, though atening, has not yet actually developed, all that is required in ny cases is rest, so as to allow the overstrained muscles and liga-nts to recover themselves; at the same time the parts should be l rubbed with stimulating embrocations, and tonics administered mprove the general tone of the system. Square-toed boots must used, so as to check any tendency to a valgoid position of the foot, l in children the heels may sometimes be slightly thickened on the er side. The patient must walk with the toes pointed forwards or

even inwards, and in some cases assistance may be obtained by
him to sit cross-kneed, in the tailor position, so as to ex
certain amount of constant pressure inwards upon the fro
feet. Regular exercises ought to be instituted, such as rai
body on tiptoe with the feet inverted; such can only be un
for a short time at first, but as the muscles regain their tone
period can be tolerated. In a later stage elastic tension a
the sunken arch is sometimes useful; Golding-Bird's sling
employed for this purpose. It consists of a loop of soft
passed round the ankle and then under the instep, its free e
drawn up on the inner side and attached to an elastic acc
which is connected with a steel garter-piece (Figs. 139 and 1

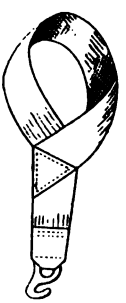


FIG. 139.—MR. GOLDING-BIRD'S SLING OF SOFT WEBBING FOR SUPPORTING THE ARCH OF THE FOOT.

FIG. 140.—THE SLING A

In still worse cases a metal spring or instep pad may be
to support the foot whilst walking, but it must be remembe
it has no curative function, and indeed by its pressure te
further to weaken the structures on the inner side of the
must fit the instep accurately and be made to pattern for e
ticular case, extending from the root of the toes to the heel.

When the affection has reached a later stage, and the d
cannot be remedied by ordinary manipulation, forcible rec
under an anæsthetic may be employed. The foot is firmly
in the two hands or in a Thomas's wrench (Fig. 141), and the
portion is forced inwards and backwards in such a way as
the scaphoid round the head of the astragalus as a fulcrum,
restore the arch. Probably a number of adhesions in the s
scaphoid and other joints will be felt to give way during this
lation. Tenotomy of the peronei is sometimes required bef
fication of the position is possible. The foot is then put up i

of Paris and kept at rest for some weeks. Satisfactory results have followed.

In advanced cases that have been entirely neglected, operative proceedings may be necessary for the relief of pain; but they are not very satisfactory, and the after-treatment is troublesome and prolonged, so that if the patient can get on comfortably with an instep pad, it is perhaps wiser to make the best of this. Ogston advises the removal of a wedge of bone from the inner side of the neck of the astragalus, but others have recommended either removal of the scaphoid or of a wedge-shaped section of the foot without respect to joints (Stokes). In either case prolonged rest and a suitable course of exercises and massage will be required subsequently, whilst an instep pad may still have to be worn.

Pes Cavus (Hollow or Claw Foot) is a condition characterized by increased concavity of the plantar arch, so that when the individual

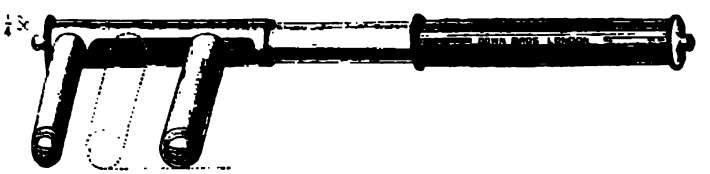


FIG. 141.—THOMAS'S WRENCH. (DOWN BROS.)

The two cross-bars are protected by thick indiarubber, and can be approximated or separated by rotation of the handle. The anterior portion of the foot is firmly grasped between them, one being placed on the dorsal and one on the plantar aspect, and forcible wrenching movements can then be carried out.

stands there is a greater interspace than usual, if not an absolute break, between the impressions produced by the anterior and posterior segments of the foot (Fig. 129, B). It is almost always an acquired deformity, although a few cases of congenital cavus have been reported. Corresponding to the increased concavity in the sole, there is a marked convexity on the dorsal aspect of the foot, whilst the toes are generally in the condition to be immediately described as hammer-toe; the heads of the metatarsal bones are unduly prominent below, and callosities often form beneath them, causing considerable pain. The condition is almost always associated with a slight degree of talipes equinus (right-angled contraction), and its method of production from this cause is as follows: The weight is normally carried to the ground mainly through the heel, but also partly through the toes; in these cases it is only transmitted through the toes and front of the foot, and since the anterior extensor muscles are probably weak, the short flexors act at an advantage, and by contracting draw the heel downwards so as to reach the ground, and thus the arch is increased.

The **Treatment** in the early stages consists in friction applied to the weakened muscles of the leg, together, possibly, with the application of a splint to the sole. In more marked cases division of the tendo

Achillis is needed, together with subcutaneous section of the te plantar fascia. The deformity of the toes usually disappears wh the equinus is corrected, but may require further attention.

Hallux Rigidus (*syn.* : **H. flexus**) is a painful condition of the gr toe, due to a chronic arthritis of its metatarso-phalangeal articulati It usually occurs in young males with flat feet. The foot is abn mally long ; its circulation is defective ; the toe itself may be in g position, but not unfrequently the first phalanx is flexed and distal one hyper-extended. It is probably due to abnormal press owing to the valgoid position of the foot, and possibly to wearing short a boot.

Treatment.—In the early stages correct the flat-foot, and see t suitable boots are worn. Failing this, careful strapping with Sco dressing may give relief, but in bad cases excision of the head of t metatarsal may be required.

Hallux Valgus.—This condition consists in a displacement o wards of the great toe from the median line of the body, as a res of which the other toes are huddl together, and in extreme cases t hallux is placed over or under the (Fig. 142). It is present in the m jority of people in some measure, owi to the usual shape in which boots a made ; but in its severer forms it ge rally occurs in elderly people, and often associated with a chronic arthri of the metatarso-phalangeal joint the hallux, the greater power of t adductor group of muscles explain the deformity. The cartilaginous su face of the head of the first metatar bone becomes exposed beneath t skin, and by the constant irritation the boot it becomes inflamed, its str ture and shape altered, and the joint more or less disorgani Two other conditions are also met with arising from this deform viz., bunion and hammer-toe.

FIG. 142.—HALLUX VALGUS WITH BUNION.

A *bunion* consists in the formation of a bursa over the head of first metatarsal bone, which becomes inflamed from cold or inj and may even suppurate, the abscess usually communicating w the joint, and leading to its disorganization. A marked bony growth is usually found under the bursa, springing from the in side of the head of the bone, and due to a localized chronic perios

The **Treatment** of hallux valgus in its earliest stages consist the use of correctly-shaped boots, with the inner border straight f toe to heel, whilst the sock or stocking should have a separate c partment for the great toe. The introduction of a toe-post betw the great toe and its neighbour is sometimes effective in gi relief. In more severe types excision of the projecting head of

l bone gives admirable results. The operation is best
by turning up a flap of skin and subcutaneous tissues
inner aspect of the head of the metatarsal with its con-
wards. The bone is then divided by a chisel and the head
allowing the toe to be easily replaced in a normal position.
is then laid down in place, and if need be shortened to meet
ements of the case. Very rarely ought the second toe to
d for this condition, as the lateral support of the great toe
eakened, and the deformity is probably aggravated. An
nion is treated by removing all local pressure, and applying
ns. If the joint is involved in suppurative disease, excision
d of the bone, or amputation of the toe, may be required.
rious cases it may suffice merely to remove the thickened

-toe.—This deformity is constituted by hyper-extension of
phalanx, marked flexion to
angle of the second, and
ion or extension of the ter-
lanx, so that the first inter-
l joint projects under the
her of the boot, whilst the
lks on the extremity of the
alanx, or even on the nail
. Corns form upon the
pressure (1, 2, and 3), especi-
e dorsal aspect, and a sub-
bursa over the head of the
nx (4), giving rise to great
inconvenience. The second
t most frequently affected,
ithout the others, but it is
a for the hallux to be thus

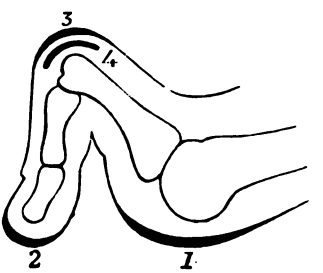


FIG. 143.- HAMMER-TOE. (AFTER KEEN AND WHITE.)

1, Callosity over head of metatarsal bone in sole; 2, callosity over end of toe; 3, callosity or corn over head of first phalanx; 4, adventitious bursa over the same bony point.

uses are numerous. It is
ly congenital, but more often acquired, and then (*a*) it may
ary to hallux valgus: (*b*) it may result from wearing short
ed boots, or very high heels; in either case the toes are
together and drawn up out of the way of pressure; (*c*) it
ntraction of the plantar fascia, and is then associated with
and talipes equinus: (*d*) paralysis of the interossei and
es may also lead to this condition in the same way that the
iffe follows ulnar paralysis.
er caused, the hyper-extension of the first phalanx is asso-
th a contracted state of the extensor tendons, which stand
evidently beneath the skin. The flexion of the second
on the first is carried to such a degree that the former bone
islocated. The prolongations of the plantar fascia on either
uch shortened, and the lower portions of the lateral ligaments
rticulations are also contracted.

Treatment may be commenced by the use of correctly-shap
but the case has usually progressed to such an extent when th
is first seen that no palliative measures are of any avail. C
is then necessary, and probably the second phalanx is so n
placed that nothing short of removal of the head of the firs
holds out any prospect of permanent relief. An incision
longitudinally over the joint, the extensor tendon being split
middle; the head of the bone is then cleared by the raspa
nipped off by cutting-pliers. No splint is required, as the pr
the dressings suffices to keep the toes in good position. S
there is but little room between the great and third toes, so t
if one corrected the deformity of the second toe there is no
it to lie comfortably; amputation should then be performed.

Metatarsalgia, or **Morton's Disease**, is characterized by se
of a neuralgic type located primarily about the head of one o
the metatarsal bones, usually the fourth, but also radiating t
and down the limb. It often occurs in gouty or rheumatic
and may be attributed to some injury; a slight degree of flat
the wearing of tight boots certainly predispose to it. It is
due to compression of the digital nerves between the hea
metatarsal bones and the ground. The foot is found to be
than usual, and the anterior transverse arch formed by th
of the metatarsals flattened out. Marked callosities or c
observed on the under surface close to the heads of the bon
more of which may be unduly prominent. In a few cases sm
enlargements have projected from the heads of the metatar
and in others definite fibrous growths have been found in th
taneous tissues; in other cases a simple peripheral neuritis ma
the manifestations. The pain is generally induced by wal
comes on in characteristic paroxysms. Lateral pressure
metatarsal bones sometimes relieves the pain. Occasionally
of osteo-arthritis are manifested in one of the neighbouring j

Treatment consists in resting the foot, whilst suitable diet a
are ordered to combat any gouty or rheumatic tendency. A
of a few weeks the patient may be allowed to walk again w
which are broad anteriorly, and fitted with an instep pad if n
Morton's recommendation—viz., excision of the head of the th
bone—may be reserved for the more aggravated and seriou

CHAPTER XIX.

INJURIES OF BONES—FRACTURES.

Contusion of a Bone and of its periosteum is usually a matter of no great moment, although the part becomes painful and swollen. Occasionally a subacute periostitis is caused in people liable to rheumatism or gout, or in the subjects of syphilis; whilst in those who are thoroughly out of health, and with low germicidal power, acute infective periostitis or osteo-myelitis, resulting in necrosis, may supervene. The **Treatment** of an uncomplicated case consists merely in the use of cooling lotions or of a bandage, whilst if periosteal thickening results, iodide of potassium may be given, and iodine paint applied locally.

Bending of Bone may or may not be associated with fracture. Bending without fracture occurs mainly in children, and in adults is only the result of some local disease. More commonly a partial or green-stick fracture is produced (p. 459), and in this the deformity can generally be corrected without much difficulty.

Fractures.

A fracture may be defined as a sudden solution of continuity in a bone, usually resulting from external violence.

Predisposing Causes of Fracture.—*Age* has a considerable influence in the determination of fractures for two reasons: firstly, because the strength and elasticity of bones vary considerably at different periods of life; and, secondly, because the exposure to injury is likewise variable. From two to four fractures are not uncommon, owing to the unsteady gait and frequent falls to which little children are liable; from four to six they are less common, the bones often bending so as to cause green-stick fractures, whilst injuries near joints induce separation of epiphyses; from six years onwards fractures are frequent enough, and increase steadily with age, old people being peculiarly liable to this form of accident, owing to the brittleness of their bones.

Sex.—As might be expected, fractures are more common in the male sex during boyhood and adult life; but up to the age of four or five they are equally frequent in the two sexes, whilst after forty-five they are more common in women, owing to their great liability to intracapsular fracture of the cervix femoris and to Colles's fracture.

Morbid Conditions of the Bones predispose to fracture in a marke manner, often leading to what is known as *Spontaneous Fracture*, which the determining force cannot be recognised or is very slig Under this heading may be included: (1) Atrophy of bone, fro whatever cause it arises. Thus, it may be of the senile type, manifested especially in the cervix femoris; or it may be due to w of use, as in a paralyzed limb or from an ankylosed joint. (2) Patie afflicted with certain mental or nervous diseases, such as gener paralysis or tabes dorsalis, are unduly liable to fracture, which m result from atrophy, but may also occur in apparently healt bones. Thus a man suffering from tabes was sitting with his thi abducted and everted in order that he might examine and dress perforating ulcer on the sole of the foot, when the shaft of the femu subsequently shown to be of normal dimensions, and apparently normal density, snapped in two. (3) Fragilitas ossium or oste psathyrosis consists in an inherited tendency to spontaneous fractur It results in a multiplicity of fractures, occurring even in childre thus, a girl, aged twelve and a half years, had suffered from forty-o fractures since the second year of life. No explanation of this co dition is known; the lesions often unite perfectly, though sometim with a good deal of deformity. (4) General bone diseases, such rickets and osteo-malacia, also predispose to fracture; in those d to the latter affection there is usually but little attempt at repa (5) Local bone disease may also constitute an important predispo ing factor by weakening its structure. Thus, sarcoma and second cancer of bone are often first recognised by causing a spontaneo fracture, whilst manipulation of a limb which is the seat of caries necrosis may lead to a similar result.

The **Exciting Causes of Fracture** are threefold: (1) *Direct viole* the fracture occurring at the spot struck, and being often transver not unfrequently comminuted, and sometimes complicated w injuries to the adjacent soft parts. (2) When due to *indirect viole* the bone gives way at a distance from the point to which the fo is applied. The accident is usually produced by the compression bending of the bone with such force as to exceed the limits of natural elasticity, so that it yields at the weakest spot. Thus, wh a person jumps from a height, the leg bones are compressed betwe the weight of the body and the resistance of the ground, and, if violence is excessive, a fracture occurs at some point of mechani disadvantage; it is often oblique, and when the displacement is co siderable, it may become compound. When the violence is of rotary character, as well as longitudinal, the fracture is likely to of a spiral type. (3) *Muscular action* is most commonly the caus fracture of small bones or of osseous prominences, into which pow ful muscles are inserted. The patella and olecranon are not un quently broken in this way, the former often occurring from sud and vigorous efforts to avert a fall. Occasionally one of the l bones, such as the humerus or clavicle, has been broken by vio muscular exertion, as by throwing a cricket-ball.

s.—A **Simple Fracture** is one in which the skin is unbroken,
rate, where the external air has no admission to the site of
. **Compound Fracture** is present when the skin or mucous
is so lacerated that there is direct or indirect communica-
en the fracture and the external air. In the base of the
icture may open up one of the deeper air-sinuses, and
comes compound without any apparent external lesion.
ns, though sanctioned by the approval of centuries, are
them good, *subcutaneous* and *open* being preferable. A sub-
fracture is often anything but a simple injury, and may
ie most disastrous consequences, whilst an open fracture
matter of comparatively little importance. Indeed, with
t appliances and methods of treatment open fractures often
· results than those that are called simple.
es are complete or incomplete, according to whether or not
uity of the bone is entirely interrupted. Various forms of
Fracture are described, and indeed the introduction of
· has shown that they are much more common than was
upposed. A *green-stick fracture* is one which only occurs in
dren, and most often in those that are rickety: curved
h as the clavicle, are usually affected, and the fracture
olves the convexity of the curve, whilst the concave half
ist as when a green bough or twig is partially broken.
of the skull may be similarly incomplete when the outer
ven in without fracture and the inner table alone splintered.
actures also are often only partial.
e **Fractures** may be *transverse*, though this is not very
oblique, arising usually from indirect violence; *spiral*, when
acts in a rotary direction as well as longitudinally; it
st frequently in the tibia or femur, and the lower fragment

The **Separation of an Epiphysis** is not an uncommon occurrence people under twenty-two years of age. It results from injury violence directed to the ends of the bones, but occasionally is m or less spontaneous, or predisposed to by disease of the epiphysis of the adjacent portion of the diaphysis (*e.g.*, from inherited syphi acute infective osteo-myelitis, or tuberculous epiphysitis). The ce of the femur, humerus, or radius are those most often affected. T line of cleavage usually runs through the soft spongy bone on t diaphyseal side of the cartilage, so that there is cartilage with spicu of bone on one side, and spongy bone on the other. The direct taken is in the main transverse, but varies somewhat with t particular epiphysis. In very young children, where the epiphy is entirely or mainly cartilaginous, the lesion is almost always a pu separation of the epiphysis from the shaft; but at a later date it u unusually extends in part through the adjacent end of the diaphy (Fig. 166). A very marked feature in all these lesions is the stripp up of the periosteum, which, though loosely attached to the sh and easily separated from it in children, is firmly adherent to t cartilage, and hence retains its connection with it, thus frequen limiting displacement. If, however, the force is sufficient, t periosteum is torn through on one side by the edge of the bone, a the periosteal 'sleeve' which thus invests it may to some ext hinder reduction. The displacement is mainly lateral, and m somewhat resemble that of a dislocation. Union usually occurs means of bone, and arrest of the longitudinal growth may follo though not so frequently as was at one time supposed, and probal only when the parts are not in exact apposition. This is a mat of special importance where one of the bones of the leg or forearm affected, since deformity of the hand or foot will result if the injur bone ceases to grow and the uninjured one continues its devel ment. Suppuration sometimes occurs as a sequela in unheal children, or when the accident is due to preceding disease of epiphysis, and may result in an acute arthritis, possibly necessitat amputation.

Partial detachment of an epiphysis (the *juxta-epiphyseal strain* Ollier) often occurs, giving rise to phenomena similar to those o sprain; if overlooked and neglected, it is likely to prove a fer source of tuberculous disease, or may interfere with the growth the limb. The essential feature is a more or less tender, but v distinct swelling of the bone close to the epiphysis, but the nei bouring joint remains unaffected. Treatment consists in immobil tion in plaster of Paris.

Signs of Fracture.- The history usually given by the patien that, as the result of some accident, he felt, or perhaps heard, so thing give way with a snap, and experienced sharp pain wh became much intensified on attempting to move the limb. examining the injured part and contrasting it with the opposite s the following points are usually noticed:

1. The *signs of a local trauma*, viz., pain, bruising, and swelling,

PLATE VI.

FRACTURE OF TIBIA, SHOWING THE ENDS OF THE FRAGMENTS SHAPED *en bec de flute*.

ram was taken from the front through a casing of plaster of Paris, the regular outline of which can be seen on the inner side of the limb.

result of the effusion of blood from the torn and lacerated structures. The amount of this may be so great as to obliterate all the ordinary bony prominences and landmarks. Blebs and bullæ sometimes form over the surface in the course of a day or two, and these should be carefully protected from infection. The discoloration continues for some time, and may spread to parts far removed from the original mischief. This infiltration of the parts with blood often leads to considerable subsequent thickening, and possibly to serious adhesions and limitation of movement: this fact is correctly utilized as an argument in favour of the treatment of fractures by an open operation. It is unusual for suppuration to occur after a simple fracture, unless the patient is very debilitated and with diminished germicidal powers.

2. *Preter-natural mobility in the continuity of the bon.* may be demonstrated by manipulation, but never unnecessarily. Impaction or non-separation of the fragments prevents its occurrence.

3. Partial or complete *loss of function* also follows.

4. *Crepitus* is obtained by moving the limb and rubbing the rough ends against one another. It can only be felt when the fragments are moveable and can be brought into contact, but not when there is wide separation or impaction. When an epiphysis has been detached, it is softer in character.

5. Change in shape of the limb or *deformity from displacement* is almost always present. There are three chief factors at work in producing deformity, viz., the direction of the violence, the weight of the limb, and the contraction of muscles, whilst injudicious movement or rough handling may aggravate it. It is always more marked in oblique than in transverse fractures, and hence is usually greater in those due to indirect violence. Various types of displacement are described, viz.: *Angular*, generally due to an increased curvature of the bone from the unbalanced action of powerful muscles, especially when the line of fracture is not far from the end of the shaft, as in fracture of the upper third of the thigh; *lateral*, where the displacement is merely to one or the other side, and most common in transverse fractures; *longitudinal*, when one fragment overlaps the other or is forcibly driven into it, causing shortening of the limb: it may also occur in the form of wide separation of the fragments, as from contraction of the quadriceps in fracture of the patella; *rotatory*, when one fragment is twisted on the other, as in fractures of the femur, where the weight of the limb causes eversion of the lower end. In flat bones—*e.g.*, the skull—deformity may exist in the shape of *depression* or *elevation*.

Such are the typical signs of a fracture, but it goes without saying that all of them are not present in every case, and that it is not always easy to ascertain the existence or not of such a lesion. Comparison with the opposite limb, and gentle manipulation to demonstrate abnormal mobility or crepitus, must be undertaken to settle this point, but no undue violence should be used. The X rays have proved of the greatest value in these cases, and where there is any

doubt as to the existence or not of a fracture, the limb should i once be skiagraphed.

General or Constitutional Effects.—*Shock* is greater or less accordi to the amount of violence and the seat of injury. It varies from mere passing faintness to the severest prostration. If the bones the head or spine are injured, special symptoms due to concussio of the brain or injury to the spinal cord may also be produced.

Hæmorrhage is rarely sufficient to give rise to general effects unle the fracture is compound, and involves some important vessel.

Fracture fever is met with in the majority of cases, commencin twenty-four hours after the accident and lasting two or three day As a rule, it is not severe, the temperature rarely rising abo 100° F. in uncomplicated cases. It is a form of aseptic traumat fever, probably due to the absorption of fibrin ferment. In co pound fractures where asepsis is not attained, any form of woun infection may result, and even general septicæmia or pyæmia.

Delirium tremens is a not unusual complication of fractures of th leg in debilitated individuals or habitual drinkers. The gener characters and treatment of the disease are dealt with elsewher (p. 259). As regards local treatment, the limb must be fixed b splints or encased in plaster of Paris, and suspended in a Salter swing so as to prevent the patient from moving the upper fragme independently of the lower.

Fat embolism results from the absorption of broken-up fat globul after any injury which causes contusion or laceration of fatty tissu when this is accompanied by tension from effusion of blood, as fractures, this process is more likely to occur. As a general rule, harm results, since the great mass of the fat is filtered off by t lungs or eliminated by the kidneys (as can be demonstrated aft death by staining with osmic acid). The pulmonary obstructio may, however, become so great as to lead to a fatal issue fro dyspnœa; whilst if the cerebral vessels are also blocked, syncope, even coma, may be induced. The symptoms, which are gradual their onset, usually commence about the third day, but may not evident for a week or more.

Complicated Fractures.—1. **Comminution** of one or both fragme is due to excessive violence, or perhaps to exceptional brittleness the bones. As long as the skin remains unbroken, sound union usually obtained, though with an increased amount of call Occasionally comminution may be a cause of non-union, a sm detached portion of dense compact tissue being wedged cross-w between the fragments, especially in the case of the tibia or fem In a compound fracture necrosis of the fragments may result fr the admission of sepsis.

2. **Fracture implicating a Joint.**—In healthy individuals no u toward result is met with; the joint is for the time filled with blo which, however, is soon absorbed, and the fissure in the cartil closed by plastic lymph. Adhesions may, however, form, as a new bony deposits, leading to defective mobility or even locking

joint. If the patient has a tuberculous tendency, arthritis will possibly be lighted up, whilst osteo-arthritis is often induced by an accident of this nature.

3. The same violence that causes the fracture may at the same time produce a **Dislocation** in a neighbouring joint. Treatment should be undertaken immediately; the limb is firmly fixed in splints commanding both fragments, and reduction attempted under chloroform. Failing this, consolidation must be allowed to proceed, and then the case dealt with as one of old-standing dislocation (p. 620). If the fracture involves, or is close to, the articular end of the bone, as is not unfrequent at the elbow and shoulder, it is advisable to operate at once, opening the joint, reducing the dislocation, and fixing the fragments; or it may be better to remove the small detached articular portion.

4. The **Main Artery** of a limb may be compressed, contused, punctured, or ruptured. Thrombosis results, with or without such an extravasation of blood as may impede the venous return. If the peripheral vessels are healthy, no permanent harm need follow, unless the vein is also implicated, and then moist gangrene is likely to supervene. If the terminal vessels are calcareous and rigid, so that there has been a preceding condition of chronic anæmia, dry gangrene will probably ensue. In the slighter cases an aneurism may subsequently develop. For further details, see Chapters VI. and XII. The **Treatment** must necessarily vary in different cases. The ideal practice would be to cut down in every case where a large artery is punctured or ruptured, remove clots, and tie above and below the injury in the vessel; but, owing to the difficulty sometimes experienced in securing aseptic conditions, it is not always advisable to do so, since the lacerated tissues are very prone to infection. Under such circumstances the main artery may be compressed or tied above the fracture, but only when the distal circulation has been re-established; in the absence of this condition, gangrene would be certain to ensue. If neither of the above-mentioned expedients can be adopted, an expectant plan of treatment must be followed. The limb is thoroughly purified, wrapped in aseptic wool, placed on appropriate splints, and slightly elevated. Should gangrene supervene, amputation is the only resource; it need not be undertaken for a few days if the limb is aseptic, so as to allow a distinct line of separation to form; but if septic, early removal through or above the line of fracture is essential.

5. Laceration of **Veins** results in extravasation of blood, which is not so extensive as when an artery is wounded, since thrombosis occurs more easily; the distal part of the limb may become congested and œdematous, and this may constitute an additional element predisposing to gangrene. Simple compression of the veins produces œdema, which, even in favourable cases, may persist for some time, needing for its removal firm bandaging, massage, and cold douching.

6. The **Nerves** of a limb may be injured at two different periods. (*a*) Immediate injury is due to laceration or rupture, either of the

whole trunk, or, as is more common, of the nerve fibrillæ, v loss of continuity of the sheath. Paralytic and anæsthetic phen follow, but are usually recovered from. (*b*) Secondary syn result from inclusion and compression of the nerve in the ca from injudicious splint pressure. Irritative symptoms in th of neuralgia and muscular spasms are first manifested, follo paralysis and anæsthesia. This usually occurs about three weeks after the accident, and may disappear in a month or persist. **Treatment** is always for a time of the expectant typ when the paralysis is immediate, since total rupture of a n rare, and restoration of function the rule rather than the exc When, however, the symptoms persist, the parts must be lai the nerve freed from adhesions, or exuberant callus remov such measures taken as will best secure the nerve from furth pression.

The **Union of Fractures** is brought about by a series of c analogous to those which we have already seen occur in wounds, except that they do not terminate in the forma cicatricial tissue, but go on to the further development of bon

When a fracture has occurred, the broken ends of the bc left rough, spiculated, and more or less separated one from the the periosteum is torn, but, according to Ollier, the rupture always complete all round, a 'periosteal bridge' perhaps per and playing an important part in the reparative process, esp if the fracture is not accurately set. The muscles and neighb tissues are also lacerated, and a varying amount of blood travasated, occupying the interstices of the wound. In the of a few hours after the parts have been immobilized, the p of repair is inaugurated by the blood-clot becoming invad leucocytes, and after a time it is absorbed, the hæmoglobin p through various stages of degeneration, and thereby staini surrounding tissues. At the same time, a rarefying inflam occurs in all the injured and lacerated structures, as a re which there is an exudation of plasma into their substance, the connective-tissue cells proliferate actively. Thus arou between the lacerated tissues and broken ends of the bone a c plastic exudation forms, which is soon converted into gran tissue, and inasmuch as the constituent cells are derived from they early manifest a bone-forming or osteoblastic function. the continuity of the bone is restored by the formation arou between the broken ends of a mass of bone, which, at first so spongy, becomes after a time firm and sclerosed, whilst a necessary excess is subsequently absorbed. Of course, changes do not occur simultaneously in all the tissues involve we must refer to them as they affect the periosteum, the m and the bony substance itself.

The periosteum becomes thickened and more vascular, a connection with the bone is loosened for a short distance

exudation of plasma, which is soon followed by a new deposit of spongy bone on the surface, as a result of the irritation. The space beneath the periosteum is quickly occupied by granulation tissue, which unites with that developed from surrounding torn structures and with that coming from the bone itself, and this ovoid mass binding the fractured ends together is known as the *provisional* or *ensheathing callus*. The transformation of this callus into bone starts from the periosteum; if it has been totally lacerated, ossification commences at the furthest point from the fracture where the irritation caused thereby is felt, and gradually spreads in. If a periosteal bridge is left, ossification commences on its under surface, and not unfrequently in skiagrams a line of newly-formed bone can be seen passing from one fragment to the other, and evidently due to this cause. Some authorities maintain that new bone derived from periosteum in this manner is always preceded by cartilage, but this is probably not the case, although the presence of cartilage in the repair of fractures is more common than was formerly supposed. It is most likely to occur in cases where absolute immobilization has not been obtained—*e.g.*, after fractures of the ribs and in children.

The medulla becomes hyperæmic for some distance from the seat of fracture and is transformed into granulation tissue, which unites with that springing up from the opposite fractured surface. Ossification commences from the inner aspect of the compact shell, from which fine spicules of bone gradually permeate the granulation mass until the whole is ossified, constituting the *internal callus*, or, better, the *medullary plug*. There is here no formation of cartilage.

Naturally, the compact bony tissue is the last to engage in these changes, and the denser the bone, the longer they are in being completed. The fractured ends become hyperæmic and rarefied, the bone cells proliferating, the medullary contents of the Haversian canals increasing in amount, and the actual osseous substance being absorbed, until the rough and spiculated surface becomes smooth and covered with granulations. These unite with the medullary plug, of which they may indeed be looked on as an extension, and finally give rise to the annular bond of union between the two layers of compact bone, to which was originally applied the name 'definitive callus.'

It will thus be obvious that the continuity of a bone is restored long before the act of repair is completed, and that such union depends on the ossification of the ensheathing callus. The newly-formed osseous tissue is at first soft and spongy, but gradually becomes denser. As the so-called definitive callus becomes stronger, the ensheathing callus disappears, and finally, if the ends are in good position, may vanish entirely, whilst the medullary plug may also be totally removed. Thus it is possible for the bone, under these circumstances, to be restored so absolutely as to show no signs of its having been fractured.

Thus far we have been supposing that the broken ends are accurately apposed and the limb immobilized; but little callus is formed (Fig. 144)

and that equally and evenly all round the site of the fracture. Where, however, movement is possible, the amount of callus is much increased.

Where the ends of the bones partially overlap (Fig. 145), the amount of ensheathing callus is correspondingly increased, and fills up all the spaces left by the overlapping of the fragments. The projecting margins of bone are rounded off, and the medullary cavities closed by plates or plugs; the amount of definitive callus is usually small, but varies with the actual conditions present. The main bond of union is the ensheathing mass, a considerable portion of which persists. Some deformity is sure to remain after such an accident, and it is unusual for the medullary canal to be restored; frequently one or more plates of bone are found crossing it.

If the fractured ends are not placed in contact at all (Fig. 146), the medullary cavity of each fragment is closed by a plate of internal callus, and union is secured by a large mass of ensheathing callus.

Fig. 144.

Fig. 145.

Fig. 146.

Figs. 144, 145, and 146.—Diagrams to represent Union of Fractures: Fig. 144, when the Ends are in Close Apposition; Fig. 145, when the Ends are only Partially Apposed; and Fig. 146, when the Fractured Surfaces are not in Contact at all.

Where comminution has occurred, the splintered fragments are matted together by an abundant formation of granulation tissue, which is subsequently transformed into callus.

The soft tissues around muscles, tendons, etc.—are repaired in the usual way, but such repair is often very imperfect, owing to the infiltration of the parts with blood and the subsequent adhesions that form, so that the functional result may be most disappointing.

The removal of the clot and the formation of granulation tissue usually take about a week or ten days, and new bone formation commences about the end of the first week. By the fourth or sixth week, according to the size and vascularity of the bone and the recuperative power of the individual, the fracture will be consolidated, but in the lower limb it is often eight weeks before the patient can bear any weight upon it. Months may, however, pass before the final stage of complete repair is attained.

In conclusion, one must allude to the fact that a sarcoma sometimes

develops at the site of fracture within a comparatively short time of the accident, and is presumably derived from an overgrowth of the callus.

The **Treatment** of simple fractures is sometimes a matter of but little difficulty, although when the bones are much displaced or comminuted, it may not be easy to correct the deformity or to maintain the fragments in position. *Constitutionally*, all that is needed is to restrict the diet and attend to the state of the bowels. This is especially needed in fractures of the lower extremity, where the patient must be confined to bed for some time. In elderly people the general health is very likely to suffer, partly from the shock of the accident, partly from the enforced and sudden change of habit, necessitating a somewhat generous diet and the administration of a certain amount of stimulant.

The **Local Treatment** of a simple fracture consists, first, in *setting* the limb—that is, in reducing the deformity and restoring the fractured ends to a normal position—and then in *fixing* it.

First Aid. In moving the patient from the spot where the accident happened, it is necessary to secure the limb temporarily in as good a position as possible; splints have often to be improvised from sticks, umbrellas, newspapers, and so forth. In a railway accident the splintered débris of the carriages may be employed for this purpose, and the upholstery of the seats as padding. A broken leg may also be firmly tied to the other limb, which is thus converted into a temporary splint.

Reduction of a fracture is usually accomplished by a combination of traction or extension applied to the lower segment of the limb, with manipulation of the fractured ends, counter-extension being at the same time maintained by an assistant. In some cases it is necessary to relax certain muscles in order to facilitate reduction; thus, in the leg, the lower fragment is drawn up by the tendo Achillis, and to relax this the knee is flexed by an assistant, who holds up the leg and makes counter-extension, whilst the surgeon reduces the deformity by traction on the lower part of the limb; section of this tendon is sometimes required in these cases. The manipulation is painful, but, if possible, an anæsthetic should be dispensed with, as one can never be certain whether or not the patient will struggle during its administration. It is unwise to use too much force in order to correct decided shortening from muscular contraction; it is better to relax the muscles by the adoption of a suitable position, or to apply continuous extension. There can be no question that in bygone days patients were subjected to a great deal of unnecessary pain from misguided efforts to 'set' the fracture.

The maintenance of the limb in a good position is provided for by the application of suitable **splints** made of wood, leather, zinc, poroplastic, etc., according to the requisites of the case. If of wood, zinc, or tin, they are usually made according to some general pattern, and fitted to the patient by means of pads; if formed of leather or poroplastic, they can be shaped so as to meet any peculiarities of the part. A paper pattern is first fitted to the opposite limb, and the splint is

then cut to the desired shape; it is softened by immersion in ho cold water, moulded to the part, and allowed to dry. Where lea is employed, the addition of a little vinegar to the water assist rendering it soft and supple. The edges and corners are fin rounded, and the interior padded with wool or lint. The general r relating to the application of splints are as follows: (i.) The jo both above and below the site of fracture should, as far as possi be immobilized; (ii.) the splints must be sufficiently large to fir encase the part, or if flat, to project a little beyond it, so that the li may be fixed by the splint, and not the splint by the limb; (iii.) ca ful attention must be given to the padding so as to prevent irritat or sloughing of the skin. In out-patient practice, where the patie are not too careful as to personal cleanliness, it is advisable to the splint with some antiseptic material, such as boracic lint, in or to prevent the development of vermin. It is better not to appl roller bandage under the splint in the situation of the fracture. T splints may often with advantage be first fixed to the limb by one two turns of strapping, and then secured by ordinary calico bandag these must not be applied too tightly at first, since the swelling of limb not unfrequently increases afterwards, and undue constrict resulting in gangrene might ensue. Moreover, a limb ensheathed bandage must never be flexed, but the flexion should always be m first; if this is not attended to, the bandage may cut into the t tissues, and by compression of the vessels cause gangrene. It is so times advisable to bandage the whole of the limb from the fingers toes upwards, so as to prevent œdema from the pressure of apparatus obstructing the venous return. The patient should alw be seen on the day following the application of the splints, and condition of the fingers or toes carefully examined; if they look al blue, or feel numb and cold, the bandages must be slightly relaxed

Various forms of **Fixed Apparatus** are used in the treatment fractures, especially in the later stages when the swelling has appeared, and in children. The materials most commonly emplo are starch, water-glass, and plaster of Paris.

The *starch* bandage is utilized only in cases where great stren and rigidity are not required. The limb is carefully padded w cotton wool, and over this are applied thin strips of cardboard soa in starch so as to fit the limb. These are firmly secured by a bandag the meshes of which are well impregnated with a starch solution, over all may be placed another bandage, the under surface of wh is also rubbed with starch. When this dries, it produces a firm ca sufficient to immobilize the limb. Should it become loose it can ea be readjusted by slitting up and paring away a portion on eac both sides.

The *water-glass bandage* is applied by first swathing the limb wi thick padding of cotton wool, or bandaging it with boracic lint; an this a coarse canvas bandage is applied, soaked in a solution of sil of soda of the consistency of treacle; several thicknesses of the ban are required in order to give it the necessary strength. This mat

is light, easily applied, and makes very little mess, but is slow in drying, taking fully twenty-four hours to become firm.

Plaster of Paris, though rather messy and increasing considerably the weight of the limb, is one of the best means of securing prolonged immobilization. (*a*) The dried plaster may be rubbed into a coarse canvas bandage, which prior to use is soaked for a few minutes in cold water, to which a little salt or alum is added in order to hasten its setting; it is then wound round the limb, which has been previously enswathed in boric lint or wool, and on the exterior of this fresh plaster of the consistency of cream is applied. To make this cream of the right strength the dried powder is cast in spoonfuls into a bowl of cold water, or a weak solution of alum, until it no longer sinks immediately, but remains floating on the surface. The mixture is then stirred with an iron spoon, and is ready for use. When the casing is sufficiently thick, the outer surface is smoothed down with wet hands, or a strip of wet bandage; the date may be advisably marked on it, and the part is slung up to dry. A Gigli saw, smothered with vaseline, may be incorporated in the dressing beneath the plaster, if it is desired to remove it early for the sake of massage, etc.; by this means it is easily cut into two pieces, which can be re-applied daily after the rubbing.

(*b*) Ordinary house-flannel forms the basis of various methods of applying plaster, *e.g.*, Croft's, the Bavarian, etc. In the former, the limb, protected by boric lint or wool, has applied to one side of it one or two thicknesses of flannel, suitably cut to shape, soaked in plaster, and with perhaps a little extra plaster rubbed in; it is fixed to the limb by a muslin bandage. When this is dry, a similar splint is placed on the other side of the limb, and again bandaged on. Division of the bandage down the front permits the removal of the appliance, the bandage over the junction of the two portions behind serving as a hinge. If necessary, thin strips of wood or tin may be incorporated in any of these arrangements, so as to add to their strength.

Early immobilization by means of plaster of Paris has been advocated by certain Continental and American authorities, and so much confidence have they in it that even fractures of the femur are dealt with in this way within a few days of the accident, and the patient allowed to walk about. Such *ambulatory treatment* has not received much support in this country, and does not seem to us in accord with the principles that guide us in restoring a limb to functional as well as mechanical soundness.

A most valuable adjuvant in the treatment of fractures is **Massage**, advocated so forcibly by Lucas-Championnière, whilst in some cases **Early Mobilization** is also desirable. It has long been recognised that after a fracture the limb remains for some considerable period weak and stiff, owing partly to atrophy of muscles, partly to cicatricial adhesions between various divided structures, and in part to contraction of ligaments in neighbouring joints, and that these disabilities increase in direct ratio to the length of time that the limb is kept at rest. It is the object of massage to prevent or obviate these dis-

abilities. In a fracture with displacement through the shaft of a long bone, the part is immobilized by splints for a sufficient time to ensure the non-recurrence of the displacement (say, two or three weeks for most bones, a little longer for the femur). Massage is then commenced, and is conducted methodically day by day, the splints being removed for the purpose and re-applied subsequently; neighbouring joints will also be rubbed, and gentle passive movements undertaken. Possibly some pain may be noticed at first, but it soon disappears, and the patient experiences a sense of comfort. Repair is hastened, but of course the patient must not put any strain on the bone until it is quite consolidated. In fractures near joints or through the articular ends of bones, it is sometimes possible to discard splints entirely, or at any rate to use them only for a short time, steadying the part by some simple contrivance, such as a sling or strapping. Massage is commenced within a few days and regularly persisted in. For such injuries as fracture of the anatomical neck of the humerus, the simpler varieties of Colles's or Pott's fracture, and for some fracture-dislocations in the neighbourhood of the elbow, this plan of treatment has been already proved to be of the greatest service. In one case of the first-mentioned of these lesions, which we treated by this means at hospital, the result was most gratifying; the limb was merely kept in a sling, and massage was commenced within three days of the accident; within a fortnight the patient (a man of over sixty years) was able to raise his arm without help to a right angle, and he went out with a limb the movements of which were almost perfect.

The increasing success of modern aseptic surgery has given considerable impetus to the **Early Operative Treatment** of fractures in order to secure complete fixation and the restoration of function in as short a space of time as possible. At first this plan was only utilized for such bones as the patella or olecranon, but at the present day there is no valid reason for refusing operation in any case where it is difficult to maintain the fragments in good position. The excellent results following operation in compound fractures, as compared with those gained by the treatment of simple fractures by prolonged immobilization, emphasize this statement. It is often impossible to co-apt accurately the fragments apart from operation, whilst the infiltration of the soft tissues with blood leads to much fibrosis and the formation of many adhesions; moreover, the more lengthy immobilization results in greater atrophy of muscles and stiffness of joints, and hence the commercial value of a working man after a fracture of the thigh or leg is very considerably depreciated, owing partly to persistent deformity, partly to the joints being stiff, whilst the period of convalescence is reckoned by months rather than weeks. Should such a case be operated on, the blood being removed, and the end of the bones freed from intervening tissues and securely united by wires, screws, or pegs, convalescence may be anticipated in a comparatively short time: the bone retains its normal length; early massage of the muscles and joints above and below becomes practicable, owing to the fixity of the limb, and thus atrophy on the one hand, and stiffness on the other, are avoided.

At the same time one must not forget that these operations are only justifiable when complete asepsis can be maintained, whilst the manipulative dexterity required in order to bring them to a successful issue is such that, in our opinion, the general practitioner, who undertakes but little operative work in the year, is not justified in performing them.

As to the actual *technique*, the incision to expose the bone should be extensive, so as to give plenty of room and allow exit to as much of the extravasated blood as possible. The ends of the fragments are then cleared, and brought into position, attention being directed to make certain that there is no abnormal rotation, and fixed by suitable forceps with a large grasp, *e.g.*, Peters'. The fragments are drilled in one or two places, and silver wire or plated screws introduced; the ends of the wires are twisted up, cut short, and the knot hammered down into the periosteum. Various encircling contrivances of the collar type have been suggested in order to assist in the fixation of the bone, and may sometimes prove useful.

Complications arising during Treatment.—(1) If an elderly patient is kept in bed for any length of time in the recumbent posture, *hypostatic pneumonia* is likely to ensue. It occurs most commonly after intracapsular fractures of the cervix femoris, and non-union often results, since the patients must be allowed to get about on crutches at an early date, the limb being merely fixed by a Thomas's splint. (2) *Bedsores* are very liable to supervene in old people with fractures which need treatment in the recumbent posture. (3) *Crutch palsy* is the result of compression of the brachial nerves between the head of the humerus and the pad of a crutch. It may affect all the nerves of the upper extremity, or may pick out any one of them, and then most commonly the musculo-spiral. It can usually be prevented by the use of spring-padded crutches with cross-pieces for the hands, so as to allow the patient partially to relieve the axillary pressure by supporting the weight of the body by means of the arms. When it has occurred, the use of crutches must be discontinued, and faradism and massage employed to the affected muscles. (4) When the muscles of a part have been firmly compressed by splints, they may undergo a rapid intrinsic atrophy with contraction, constituting what is known as *Ischæmic contracture*. This is observed most frequently in the hand, and is then due to the direct pressure of the splints on the muscles of the fore-arm. The fingers become clawed and flexed, and the wrist is sometimes hyper-extended. It is recognised from the results of a nerve lesion by the absence of sensory or trophic phenomena. Treatment consists in exposing and lengthening the contracted tendons, if massage fails. The outlook is, however, not very promising. (5) *Gangrene* may arise from fractures in a variety of ways: (i.) From the immediate effects of the injury, either by its direct action on the tissues, or by causing arterial thrombosis in a limb with atheromatous vessels, or from rupture of the artery with consequent venous thrombosis, owing to the pressure of the extravasation; (ii.) by the supervention of spreading gangrene in a compound fracture; (iii.) from errors in the course of treatment, as by bandaging the limb too

tightly, so as to constrict the vessels; or by the bandage becomi unduly tight, owing to the subsequent swelling of the limb; or flexing a joint after bandaging it, the bandage cutting into the s tissues; or by the localized pressure of a splint which has been i sufficiently padded. Moist gangrene is the type met with in all cas except when the limb has been previously drained of its fluids by atheromatous condition of its vessels. (For rules of treatment, s Chapter VI.)

Compound Fractures.

A compound fracture is one in which there is a communicati between the external air and the site of injury. It is produced direct or indirect violence, and may be associated with any of t complications or modifications met with in simple fractures. T bones may be but little displaced, or may protrude through the openi in the skin, and then be bruised or comminuted, and even contam nated with dirt or mud.

The chief dangers of compound fractures are, firstly, *hæmorrha* the blood, instead of collecting within the tissues of the limb, escapi externally, although subcutaneous extravasation is not uncommo and, secondly, the advent of *sepsis*. The latter is the more importa and may lead to the most serious consequences. Portions of mus and periosteum, which in a simple fracture would be removed incorporated in the new formation of callus, become inflamed in sep cases, and even slough. Small isolated fragments of bone are alm certain to necrose if suppuration ensues, whilst the severest forms septic osteomyelitis may occur, endangering the patient's life pyæmia. Such results are more likely to follow when the exter wound is small and insufficient provision has been made for drain Immense advances in the treatment of these conditions have b made since the introduction of antiseptic surgery, and where such regularly and efficiently practised these dangerous complications rarely seen.

The **Method of Union** of a compound fracture is much the same that occurring in simple fractures. If the wound can be rende aseptic, it may be closed by suture, and if it heals by first inten the fracture is practically converted into a simple one, and is repa accordingly. If, however, suppuration occurs, it is probably atten with a greater or less amount of necrosis, and possibly diffuse flammation of the soft parts; the wound will therefore remain o for a time, varying with the acuteness of the local phenomena. gradually closed by granulations, which extend upwards from be and the deepest part of this granulation tissue, which is derived f the bone and periosteum, and contains osteoblastic elements, wil transformed into callus, and finally into true osseous tissue. Re is much slower under these circumstances than in a simple frac since the suppuration may have interfered with the osteogenetic po of the periosteum, and thus the new bone formation is depe solely on the osseous tissue itself, which is always slow to react.

The **Constitutional Symptoms** following compound fractures are much more marked than in simple cases. Even where sepsis is prevented by efficient treatment, some amount of aseptic traumatic fever is certain to supervene for a few days, whilst, if infection occurs, there is a period of marked febrile disturbance for a week or ten days, similar to that which is seen in all septic lacerated wounds (p. 230).

In the **Treatment** of compound fractures, the main object is to render the wound aseptic and to give efficient exit to the discharges. For this purpose the patient should in most cases be anæsthetized, the wound enlarged and thoroughly washed out, and even scrubbed, with some potent antiseptic, such as carbolic lotion (1 in 20). Loose fragments of bone are removed, and portions denuded of their periosteum may be taken away lest necrosis should ensue; where fragments retain any considerable connection with the soft parts, they may be left without fear, and of course as little periosteum should be removed as possible. When a sharp end of one of the fragments is protruding through a small opening in the skin, it is first thoroughly purified before attempting its reduction, and then replaced, after enlarging the wound in the skin, or a portion is sawn off. Hæmorrhage is dealt with in the usual way, and the fragments are placed as nearly as possible in their normal position. If the fragments can be brought accurately into position, it is well to fix them by some mechanical appliance; but where the ends of the bones are much comminuted, the small portions must be arranged in position as well as possible, and no attempt made to wire them. A good-sized drainage-tube is inserted, and, if need be, counter-openings are made; the external wound is closed or not according to circumstances and dressed, and suitable splints are then applied. Under such a régime the majority of cases do well. Immoveable apparatus may be used after a time, windows being left in the plaster casing to allow wounds to be dressed.

In compound fractures which have been attended with complications directed to vessels, nerves, and neighbouring soft parts or joints, the prognosis and course of the case may be considerably modified; treatment suitable to each of these conditions must be adopted.

The question of **Amputation** will necessarily be raised in the more serious cases; but it is unnecessary to add anything here to what has already been stated in Chapter IX. (p. 231).

Ununited Fractures.

Three varieties of ununited fracture have been described: (1) *Absolute non-union* is said to be present when no attempt at repair is made. This rarely occurs except when some definite bone disease exists, such as sarcoma or osteo-malacia, or when in a very debilitated patient there has been no attempt to fix the limb. (2) *Fibrous union* consists in the development of a more or less firm mass of connective tissue as the bond of union between the ends of the bones, which are either rounded off and closed by a thin plate of bone or cartilage, or are sometimes atrophic and pointed. (3) A *false joint*, or *pseudarthrosis*,

is a condition in which the ends of the fragments are covere
by bone or cartilage, and more or less altered in shape, s
form a shallow ball-and-socket joint, the capsule being repr
by the surrounding fibrous tissue, and the synovial cavity
adventitious bursa, which results from the friction of the tw
(Fig. 147).

The most common situations for ununited fractures are pr
processes of bone to which powerful muscles are attached,
the patella, olecranon
coid process, posteri
of the os calcis, etc.;
in long bones the m
the shaft of the h
and the upper and
thirds of the femur
favourite sites.

FIG. 147.—UNUNITED FRACTURE WITH FALSE JOINT. (FROM COLLEGE OF SURGEONS' MUSEUM.)

Many different
may be associated in
mining the defectiv
of fractures, but the
ing are the more imp
(1) Want of appos
the bony ends, ow
muscular action—*e.g.*
patella, when the tw
ments are widely sep
or in the femur, whe
may overlap; (2) th
position of fluid o
substances as musc
aponeurotic tissue,
tached fragments o
pact bone; (3) want
one of the most c
causes, as in the middle of the shaft of the humerus, where,
the elbow is well supported, complete immobility cannot be ob
and non-union is likely to result; (4) defective blood-supply to
both fragments, as by injury to the nutrient artery, or as in
capsular fracture of the cervix femoris, where the only sou
supply to the upper fragment is a small twig derived fr
obturator artery running along the ligamentum teres; (5) loca
t'ons of the bone, such as malignant tumours, destruction
periosteum by inflammation, or the undue pressure of pads u
newly-formed callus; (6) general bone disease, as osteo-malac
(7) general constitutional weakness or debility, sometimes
definite diseases, such as scurvy or severe syphilis, someti
general asthenia or alcoholism. It has been proved that
pregnancy, and the cancerous cachexia do not, as used formerl
stated, predispose to this condition.

The **Signs** of an ununited fracture are usually obvious, t

between the fragments being easily obtained, although without crepitus.

The **Prognosis** is good if suitable treatment is adopted. In children, however, the condition is often maintained even after operation, and, in fact, may be aggravated by it, the ends of the bone becoming atrophic, rounded, and covered by cartilage; in such the final resource is not unfrequently amputation.

The **Treatment** of ununited fractures is now conducted on perfectly definite lines. (1) If in good position, the parts are refixed in an immoveable apparatus, preferably plaster of Paris, for six weeks, whilst means are adopted to improve the general health, as by a stay at the seaside and the administration of tonics. (2) Failing this, the ends of the bones may be well rubbed together, so as to excite local action, and the parts again fixed. Regular massage is useful, and enforced congestion of the limb by an elastic tourniquet applied for an hour or two daily has also been recommended. (3) Should this be unsuccessful, or if the ends of the bone are not suitably apposed, operative measures must be undertaken. If the bone is tolerably superficial, and the ends not very far apart, they should be exposed, sawn into shape, fitted together (preferably by a dove-tailing process), and secured by stout silver wire, which may be left *in situ* permanently, and if aseptic becomes encapsuled. If, however, the bones are deeply placed, so that the operation to expose the ends and fit them together becomes a very severe one, it is often better practice to leave them in their bad position, and merely fix them by the insertion of ivory pegs or nickel-plated screws. Thus, in the upper end of the femur non-union is usually associated with overlapping of the ends of the bone to a considerable extent. To expose and fit these together would necessitate a very extensive dissection; it is wiser in such cases merely to cut down in front upon the upper anterior fragment, drill two holes in different directions through both fragments, and into these insert suitable ivory pegs. Two holes should always be employed, to prevent slipping of the fragments during the necessary manipulations; whilst one drill is removed for the insertion of the peg, the other holds the bone steady. As a rule, the pegs may be allowed to remain permanently, but occasionally they become loose in three or four weeks, and need removal. Their presence causes the formation of a large amount of callus, and by this means the fracture is consolidated. It is well to examine the fracture by the X rays from time to time to see that the bones are still in position, and for this purpose the dressings need not be removed, if metal splints are not used.

Disunited Fracture is the term applied to a rare condition, in which a fracture which had been firmly united becomes separated again. It is only met with when the individual develops some extremely debilitating disease, such as scurvy, and may be recovered from under suitable treatment directed to the cause, and by fixation of the parts.

Vicious Union (Fig. 148) of fractures results either from imperfect adjustment of the ends of the bone prior to placing the limb on an immoveable apparatus, or from the parts not being kept at rest, and hence becoming subsequently displaced. Various kinds of deformity

and disfigurement, accompanied or not by loss of function, may resu from this accident. In some cases it may be advisable to leave thin alone, but where the deformity or functional disability is seriou means must be taken to remedy matters. If observed early, it is n difficult to re-adjust the parts by simple pressure under an anæstheti if necessary re-fracturing the bone; but this should only be unde taken whilst the callus is soft, *i* within three or four weeks of th accident. Some surgeons appl this method of *osteoclasia* eve when consolidation has been a complished, using for the purpo powerful levers and clamps; b in our opinion such treatment i most undesirable and highly u scientific, since it is difficult t gauge accurately the amount o damage concurrently inflicted o the soft parts. We much prefe the *open* method, cutting down o the bone, re-dividing it, removin redundant callus, and fixing th fragments by silver wires, pegs, o screws.

FIG. 148. – VICIOUS UNION WITH MARKED DEFORMITY AFTER FRACTURE OF FEMUR. (KING'S COLLEGE HOSPITAL MUSEUM.)

Special Fractures.

Bones of the Face.—The **Na** bones are broken as a result o direct violence, by the fist, cricket-ball, stick, etc. The fra ture is generally transverse, an situated just above their fre margins; occasionally, wh greater force is used, it occurs close to the root of the nose, and m then be associated with fracture of the frontal bone or base of th skull. In young people the cartilages alone may be separate There is usually considerable deformity from depression or later displacement of the fragments, although it may at first be mask by the amount of bruising. Severe epistaxis, surgical emphysem and cerebral symptoms, are sometimes met with as complication The fracture very readily becomes consolidated, and the deformi is thus often irremediably fixed, unless its presence is determin at once, and suitable treatment adopted. The **Septum** is sometim broken and depressed, in association with or apart from the abo injury. Lateral displacement occurs, causing unilateral nasal o struction and some amount of obvious deformity. The **Treatment** these cases consists in immediate replacement of the bones, advisa under an anæsthetic; this may be accomplished by the pressure some blunt instrument, such as a pair of padded dressing-forceps,

blades of which are introduced within the nostril, or by distension of a suitable indiarubber bag with air or water. A pad of lint or gauze soaked in carbolized oil is then inserted to maintain the position, and a guttapercha or zinc splint moulded to fit the bridge. In old-standing cases, where there is much depression, but little can be done by operation, but subcutaneous injections of paraffin may improve the appearance (see Chapter XXVIII.). Lateral displacement can usually be remedied by mechanical appliances or operation.

The **Lachrymal** bone has been broken by direct violence, the fracture usually extending from the nasal bone to the lateral mass of the ethmoid. Interference with the flow of tears and surgical emphysema are the two most marked symptoms.

The **Malar** bone is but rarely broken without the other bones of the face being involved; fracture is almost always associated with damage to the anterior wall of the antrum and considerable depression of the fragments. An attempt should be made to replace the parts by pressure from within the mouth.

The **Zygoma** is fractured by direct violence applied from without; the broken portion may be depressed below the surface, but vertical displacement is limited by the attachment of the masseter below and of the temporal fascia above. Reposition, either by manipulation from within the mouth, or even by operation, is essential in order to prevent interference with the subsequent mobility of the jaw. Perhaps the simplest plan to adopt is to encircle the zygoma subcutaneously with a loop of silver wire and drag it up to its natural level.

The **Superior Maxilla** is invariably broken as a result of direct injury, such as a gunshot wound or a blow; it is almost always compound, and often bilateral. The alveolar portion is either partially or entirely detached, or a transverse fissure, extending as far as the pterygoid processes on each side, may render the whole palate and lower part of the facial skeleton moveable. Not unfrequently all the bones of the face are smashed and comminuted, severe haemorrhage sometimes resulting from wounds of the internal maxillary artery or its terminal branches. As a rule, **Treatment** consists in merely keeping the patient quiet and applying cooling lotions; union occurs with great readiness, but is sometimes associated with suppuration and necrosis. The patient must be fed by a tube, and a carefully-fitted dental plate should be applied to a broken alveolus.

The **Inferior Maxilla** is usually fractured by direct violence, but occasionally by force applied indirectly, as when a carriage passes over the bone, laterally compressing the two sides, and leading to a fracture in the middle line. Most frequently the lesion is a little in front of the mental foramen (Fig. 149), this being a weak spot at the junction of two strong parts, viz., the symphysis menti, and the alveolar process carrying the molar teeth; the bone is further weakened by the long narrow alveolus which lodges the canine tooth. This fracture is sometimes bilateral when great violence has been applied to the symphysis. A solution of continuity also occurs close to the angle behind the molar teeth, whilst the coronoid process and

condyle have occasionally been broken, the former only as a result great force, *e.g.*, a gunshot wound, the latter from either direct indirect violence.

The **Signs** of fracture are very evident if the lesion is situat anteriorly; but when behind the teeth, diagnosis may be much mo difficult. The usual variety is almost always compound, owing the firm attachment of the muco-periosteum to the alveolar bord Laceration of the gums, the blood-stained saliva soon becoming fœti the irregularity in the line of the teeth, and the easily elicited crepitu all constitute a typical picture. There is often considerable pai owing mainly to the tearing of the mucous membrane, but possibl due to implication of the inferior dental nerve. The main trun however, generally escapes, owing to the position of the fracture

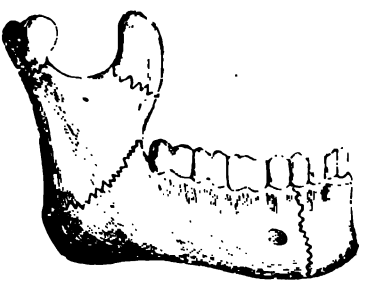


FIG. 149.—LOWER JAW, INDICATING THE MOST COMMON SITES OF FRACTURE.

FIG. 150. — APPLICATION OF FOUR-TAILED BANDAGE IN FRACTURE OF LOWER JAW

front of the mental foramen, whilst in those behind there is but lit displacement. Smart hæmorrhage sometimes occurs from laceratio of the accompanying artery. The posterior fragment is usually rais whilst the anterior portion is depressed by the action of the hy muscles, and may override the other, owing to the direction of fracture, the anterior fragment including more of the outer surface the bone than the posterior. The direction of the displacement reversed in some cases. When situated at the angle or *in the vert ramus*, there is such equal muscular support on the two sides that l little displacement results. When the fracture passes *through the n of the condyle*, that process is drawn forwards and inwards by external pterygoid, whilst the body of the bone is freely move antero-posteriorly, and displaced towards the fractured side. Wh the *coronoid process* is detached, it is dragged upwards by the tempo tendon, but no great displacement can occur, owing to the extens attachment of the tendinous fibres.

In those cases of fracture which are compound (and this inclu the great majority), septic inflammation of the ends of the bone c

ensues, leading to localized necrosis, and sometimes to septic pneumonia, or even to general pyæmia.

The **Treatment** of a fractured mandible is frequently a matter of difficulty, owing partly to the septic element, and partly to the difficulty of fixing the jaw without interfering with the patient's nutrition; hence the co-operation of a skilled dentist should always be secured.

1. As a temporary measure, and indeed as a permanent appliance in simple cases without much displacement of the fragments and where dental assistance is not to hand, all that is needed is an efficient four-tailed bandage. This is made by taking a piece of calico 4 inches wide and 1 yard in length, and splitting each end into two, leaving about 8 inches undivided, in the centre of which a small longitudinal cut is made for the insertion of the chin. The two lower tails are then drawn up and tied over the vertex, whilst the two upper ends are secured behind the occiput, and then, to prevent slipping, are

FIG. 151.—LEATHER SPLINT FOR LOWER JAW.

FIG. 152.—LEATHER SPLINT APPLIED.

knotted to the ends of the former (Fig. 150). This apparatus is maintained firmly in position for three weeks, the patient being fed through a tube passed between the teeth or through the gap behind the last molar, and all movement of the jaw prohibited. The mouth should be frequently washed out with some antiseptic lotion. Union is usually secured in five weeks.

2. If patients are unruly, or if the above apparatus fails to maintain the fragments in position, a moulded guttapercha or leather splint may be applied, made in the shape indicated in Fig. 151, the upper portion being folded back, and the lower portion drawn up around the bone. It is lined with lint, and secured by bandages or tapes passed through holes, and tied as shown in Fig. 152.

3. Where there is much displacement, the fragments must be fixed. Wire sutures passed around or between adjacent teeth and tied are distinctly objectionable, causing the teeth to become loose and perhaps diseased. *Hammond's wire splint* is the best apparatus to employ. It consists of a firm wire collar or framework (Fig. 153), which encircles the whole series of teeth in the lower jaw. It is accurately fitted by

a dentist, firstly, to a cast of the jaw, subsequently to the and is fixed by several wires passing from one half to between the teeth.

4. In cases where a Hammond's splint fails in remedyi placement, or where the teeth are defective, a Kingsley's (Fig. 154) may be used with advantage. It consists of a splint fitted ove or alveolar proc mandible, and for a sufficient d each side of th to steady the f To the front o attached curv bars, which ex ways from the the mouth over t It is kept in p passing a ban the bars and chin (Fig. 155), a thereby excelle lization of the f even when the opened.

FIG. 153.—HAMMOND'S SPLINT FOR FRACTURE OF LOWER JAW.

5. *Wiring of ments* together may be required in a few cases. The wire passed either through the bone below the teeth—a task n accomplish without an external wound—or through the em of neighbouring teeth, which are extracted for the purpose.

When septic inflammation occurs of such severity as necrosis, it is often best to delay all operative treatment sequestrum has been detached, and the parts are more h patient's mouth in the meantime being frequently cleansed septic lotions. Wiring of the fragments may then, if nec undertaken with good hope of success.

Fracture of the Hyoid Bone is uncommon, arising usually f violence, such as a forcible grasp or the constriction of t hanging. Either the body may be broken, or one of t separated. The symptoms produced are: Pain on attemptin the tongue, jaw, or neck; a husky voice; and deformity, sometimes be detected from without. Occasionally the muc brane is perforated, and bleeding into the pharnyx may oc œdema of the glottis may supervene. The fragments approximated as well as possible by manipulation between in the mouth and the hand outside, and the neck then f poroplastic collar.

Fracture of the Ribs may arise in two distinct ways: (1) violence, as by blows or stabs, the fragments being drive

and damage to the underlying pleura, lungs, liver, or diaphragm, being very likely to occur; or (2) much more frequently by indirect violence, as when the chest is compressed between a cart-wheel and the ground, or between a wall and the back of a waggon. The ends of the ribs are then approximated beyond the limits of natural elasticity, and they give way at the most convex part—*i.e.*, near the angle. The viscera may be contused, but less often than in the former class, although hæmothorax from rupture of the parietal pleura is not uncommon. One or several ribs may be broken, but the displacement is rarely marked, except in cases due to direct violence, where several ribs have been 'staved in.' The fifth to the eighth ribs are those usually injured, being more prominent and fixed at both ends; the first

FIG. 154.
KINGSLEY'S SPLINT FOR FRACTURE OF LOWER JAW

FIG. 155.
KINGSLEY'S SPLINT APPLIED.

and second ribs are so well protected by the clavicle as to be seldom broken by direct injury, although great violence from above downwards to the outer end of the clavicle may lead to such an accident; the lower ribs often escape on account of their greater mobility. Elderly women and persons suffering from general paralysis of the insane are specially prone to this fracture.

The **Symptoms** are tolerably obvious, viz., a sensation of something snapping or giving way, a sharp localized catching pain at the site of the injury, increased on deep breathing and coughing, and possibly some local extravasation and swelling. Pain is also elicited by combined pressure upon the sternum and spinal column, whilst the fracture may be evident on palpation, or crepitus detected when the patient coughs or on auscultation. When several ribs are driven in, a marked

depression results, but if a single bone is broken in a fat indiv the diagnosis may be extremely obscure. For the clinical hist lesions of the lungs or pleuræ, see Chapter XXXII.

Treatment.—The affected side should be firmly strapped with l strips of adhesive plaster, so as to limit its movements. The s 1½ to 2 inches wide, should extend beyond the middle line, both and back, and are applied from l upwards whilst the chest is in a st forcible expiration, each strip ov ping the preceding one and crossin direction of the ribs (Fig. 156). A woollen bandage should then be ap over all. If the ends of the bon driven inwards, strapping can rare borne, as it tends still further to in or compress the lung. Under such cumstances all constriction of the must be avoided, the patient being fined to bed with a sandbag betwee shoulders, and the arm bound t side. When the lower ribs are be tight applications are generally co indicated, since the diaphragm is lik be irritated, and troublesome hicc may result. Ribs unite readily, but v considerable amount of callus, owing to the mobility of the fragm

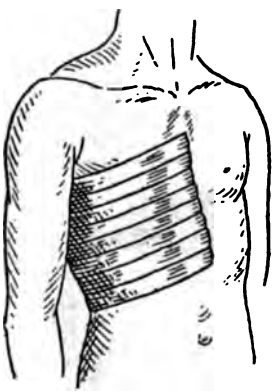


FIG. 156.—METHOD OF STRAPPING BROKEN RIBS.

Separation of a Costal Cartilage sometimes occurs, giving rise t same symptoms and requiring the same treatment as a broke Occasionally the cartilage itself may be fractured. In each cas resulting bond of union is osseous.

Fracture of the Sternum is almost always due to direct viol although it has been known to yield from excessive flexion o body after fracture of the spine, or from muscular strain d parturition. The line of fracture is usually transverse, the giving way either between the manubrium and gladiolus or a below this level. The fragments may remain *in situ* or the u portion be displaced backwards, the deformity in such cases l very evident, and great dyspnœa resulting. As a late effect, anet of the arch of the aorta may occur.

Treatment.—The patient should be kept in bed with a pillow bet the shoulders, and the chest strapped as for fractured ribs. I patient cannot bear this position, he should be allowed to sit up the body leaning forwards. Reposition can sometimes be effecte manipulation, combined with extension of the spine.

Fractures of the Upper Extremity.

Fracture of the Clavicle.—No bone in the body, with the exce of the radius, is broken more frequently than the clavicle; this i to its exposed position and its buttress-like action in keeping ou

point of the shoulder, so that every shock to the arm is transmitted through it to the trunk. Hence, although sometimes broken by direct violence, fracture is usually due to force directed to the hand or shoulder, such as a fall from a horse. It is more common in men than in women, and in children is often of a greenstick nature. The bone may yield in four different situations, viz.:

1. **At the Sternal End**, an unusual occurrence, due to direct or indirect violence. The displacement varies with the line of fracture; if transverse, it is slight; but if oblique, and this is most usual, the outer fragment is drawn downwards and forwards as in the next variety, though to a less degree.

2. **Through the Greater Convexity**, the commonest situation. The bone yields about its centre, or a little external to it, and the line of fracture is slightly oblique, running from before backwards and inwards. The displacement is quite characteristic, and is present in any fracture situated between the rhomboid ligament on the inner side and the coraco-clavicular ligaments on the outer, being less marked, however, when the fracture is nearer the extremities than in the centre of this space. The patient gives a history of injury and severe pain, supports the elbow with the other hand, the head being bent over to the affected side to relax the muscles of the neck, and the arm is powerless. The point of the shoulder is less prominent than usual, being approximated to the middle line, and on a lower level than the other, whilst at the seat of fracture is a slight bony projection. This deformity is accounted for by a displacement of the whole outer fragment downwards, forwards, and inwards (Fig. 157); the outer end, however, is more displaced than the inner, so that the fractured surface of the outer fragment looks upwards, inwards, and backwards, although it is placed immediately below the inner fragment. The deformity is mainly due to the weight of the arm acting upon the outer fragment when the buttress-like action of the bone is gone, allowing the scapula, to which it is firmly united by ligaments, to embrace the curved thoracic wall, from which it is usually separated. Muscular action can only be looked on as an accessory, and is not the main cause of this displacement. The position of the inner fragment is probably but little altered, since it is held in place by the rhomboid ligament; the apparent

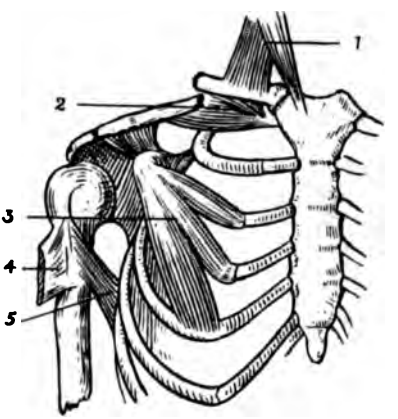


FIG. 157. FRACTURE OF CLAVICLE THROUGH GREATER CONVEXITY.

1, Sterno-mastoid; 2, subclavius; 3, pectoralis minor; 4, pectoralis major; 5, latissimus dorsi.

projection of its outer end is due rather to the depression of fragment than to elevation of the inner by the sterno-mastc

3. **Between the Coraco-clavicular Ligaments**, usually ari direct violence, and with but little displacement, owing to t of the ligaments and to the fact that the periosteum is not t The signs of local trauma and crepitus are, however, prese not very obvious.

4. **At the Acromial End**, external to the trapezoid liga again, usually produced by direct violence. The inner retains its position unaltered, but the outer fragment is dra by the weight of the arm, and forwards by the action of th so that it lies at right angles to the rest of the bone.

Complications arise most frequently in cases produced violence. The subclavian vein may be injured, or the brachi and even the dome of the pleura and the subjacent lung wounded. Gangrene of the arm has resulted from obstruc vessels.

Treatment.—Where there is little or no displacement, needed is to immobilize the arm in a sling and to keep the pa

For fractures with displacement many different plans of have been adopted. In order to replace the fragments, t should stand behind the patient, who is seated, with his kn the scapulæ; traction is then made upon the shoulders, an of the acromion is drawn upwards and backwards. To m fractured ends in apposition the following methods hav commended: (*a*) The simplest, which can always be app emergency and in simple cases permanently, is that kno *three-handkerchief plan.* Two large handkerchiefs, folded d rolled into bands, are placed vertically, one over each sh under each axilla; each is lightly knotted behind, and the e tied to the opposite handkerchief across the middle line. means the point of the shoulder is kept outwards and b The third handkerchief is now folded crosswise and used to support the elbow, which is drawn well forwards, the h placed over the sound clavicle. If this apparatus is emp manently, the knots must be examined every few days, es first, as the handkerchiefs always stretch a little and require tightening. (*b*) *Sayre's method* is very useful, especially i children. A long strip of adhesive plaster, 3½ inches wi according to the size of the patient, is passed round the ar below the axilla, as a loop, with the sticky side out, and th the body with the adhesive side inwards, the arm being d back, and the loop and ends secured by stitches (Fig. 158 has been firmly applied, it may now be used as a fulcrum, the elbow is drawn forwards, the point of the shoulder i backwards and outwards, and thus the main deformity is Another strip of a similar width is applied over the elbo hole being cut to receive the point of the olecranon), and by t the arm is raised and drawn forwards so that the hand can b

the opposite shoulder, and the desired position is thus maintained. In children more than one strip of plaster will be needed in order to secure the arm, whilst an additional bandage is also useful. Excellent results follow this plan of treatment. (*c*) In ladies, where even the slightest deformity is undesirable, it is better to confine them to bed; the head is kept low without a pillow, and a sandbag placed between the scapulæ, the arm being bandaged to the side. This position must be maintained for three weeks, and even then only very limited movement allowed. (*d*) The old-fashioned plan of treatment by means of an axillary pad, a figure-of-8 bandage crossing behind the shoulders, and an elbow sling, has been to a large extent superseded by Sayre's and other methods. Union is probably attained in four weeks, but the movements of the arm should be restricted for some time longer. A considerable amount of callus is usually formed, and there is very likely to be some slight persistent deformity.

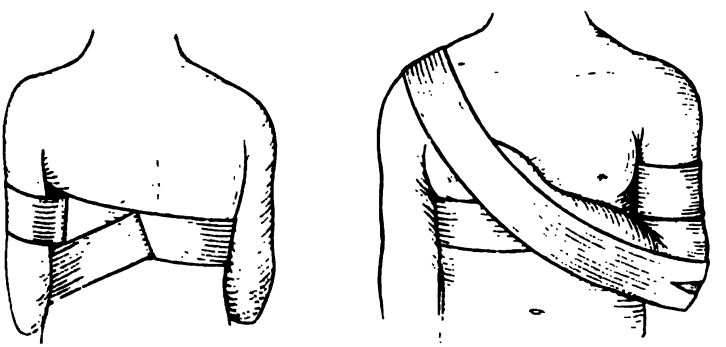


FIG. 158.—SAYRE'S METHOD OF STRAPPING FOR FRACTURED CLAVICLE.

Fractures of the Scapula.—1. The **Acromion Process** may be broken by direct violence applied to the point of the shoulder. The arm hangs powerless, supported by the other hand, and the shoulder is flattened. The irregularity of the bone can be readily detected, and crepitus can be elicited by raising the elbow and rotating the arm. Occasionally merely the tip is detached, and then the above signs will not be present. **Treatment** consists in raising the elbow, and bandaging the arm to the side.

2. The **Coracoid Process** is rarely fractured, and then by direct violence. There is but little displacement, on account of the many powerful ligaments attached to it, and the only treatment needed is to raise the elbow by a sling and keep the arm to the side.

3. The **Body** of the scapula is broken as a result of considerable direct violence, which is often primarily received by the spine. There is but little displacement when the fracture is comminuted or transverse just below the spine. A longitudinal fracture may, however, result in the inner or vertebral fragment being drawn upwards

and outwards in front of the axillary portion by the serratus magnus and levator anguli scapulæ. The diagnosis is made by grasping the bone firmly, and moving one fragment on the other; crepitus may thus be obtained. **Treatment** consists in bandaging the arm to the side, and possibly applying strapping to support the fragments.

4. Fracture of the **Neck** is usually due to great violence directed to the shoulder, but is uncommon. A portion of the articular surface is broken off and displaced downwards in some cases of dislocated shoulder (Fig. 159, A); or the fracture has been known to run through the anatomical neck (Fig. 159, B), a condition causing a lengthening of the arm and displacement downwards of the head of the humerus. **Treatment.**—The arm must be kept to the side and raised.

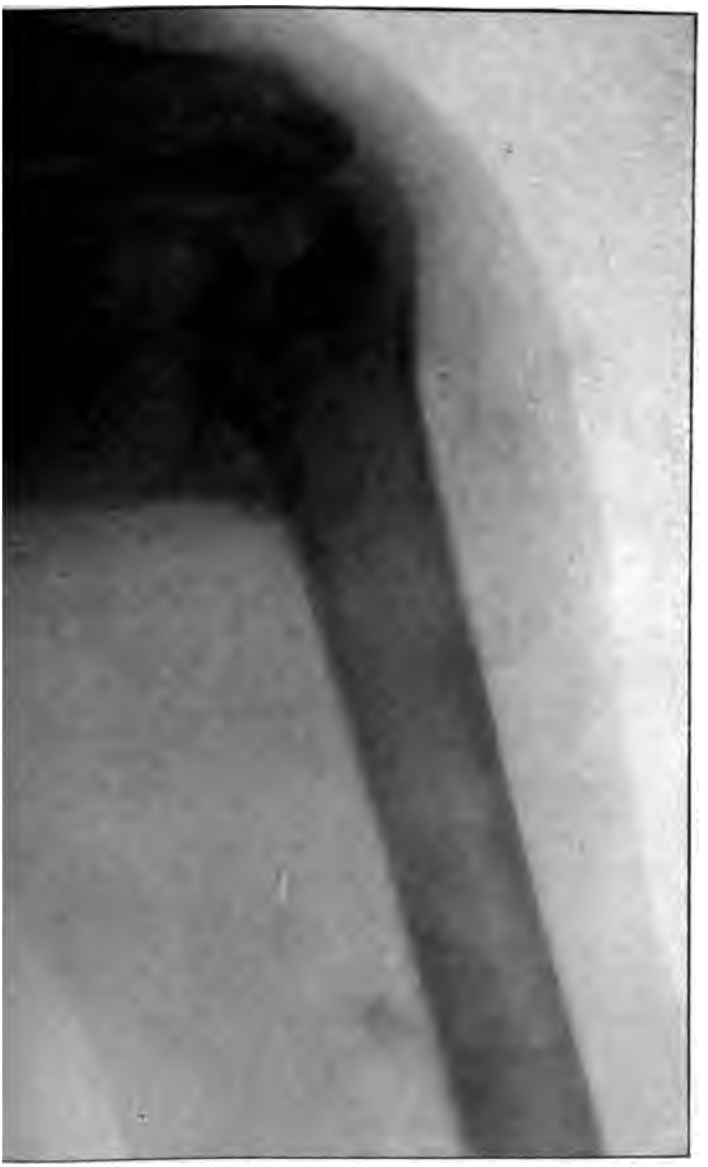
FIG. 159.—FRACTURES OF THE NECK OF THE SCAPULA.

A, Through the glenoid fossa; B, through the anatomical neck; C, through the surgical neck.

More commonly, however, the fracture involves the **Surgical Neck** (Fig. 159, C), extending from the suprascapular notch above to just below the origin of the triceps muscle, so that the detached fragment includes the coracoid process. Flattening of the shoulder results, with prominence of the acromion, lengthening of the arm as measured from the acromion to the external condyle, and crepitus on raising and rotating the limb. **Treatment.**—The bone is replaced by pressure in the axilla, if necessary under chloroform, and fixed by an axillary pad or a ∩-shaped leather splint, whilst the arm is kept to the side.

Fractures of the Upper End of the Humerus.—1. Of the **Anatomical Neck**, the so-called 'Intracapsular Fracture' (Plate VII.). This is usually due to blows or falls on the shoulder, less commonly to indirect violence. The shoulder becomes greatly swollen from effusion of blood, making a satisfactory examination almost impossible for some days; pain on movement is severe, but crepitus may perhaps be felt on rotating the arm; there is usually about half an inch of shortening. In most cases the upper fragment is not totally detached, but remains

PLATE VII.



Impacted Fracture of Anatomical Neck of Humerus.

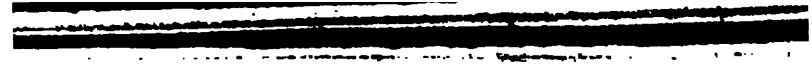


PLATE VIII.

FRACTURE OF SURGICAL NECK OF HUMERUS.

cted with the rest of the bone by a few shreds of capsule, and ecrosis is prevented. Should impaction occur, the small upper ent is driven into the lower, and marked deformity of the head bone results, which can occasionally be detected by palpation the axilla. If the articular surface is completely detached, it e dislocated at the same time, and felt as a distinct fragment in xilla. Examination must be conducted with great care lest tion be disturbed, or any capsular attachments broken through; utine use of skiagraphy in all serious lesions of the shoulder rs such manipulation less necessary than formerly. Repair place mainly from the lower and, owing to the difficulty of ing and immobilizing the frag-s, a considerable mass of callus ally formed. **Treatment.**—When is but little displacement, ng more is required than to the elbow and keep the arm to side by a suitable bandage, h a comfortable sense of sup-is given by placing a pad in the . Massage commences early—t the fourth or fifth day—and ve movements a few days later. e more serious cases a pad or aped splint is placed in the , and retained in position by a bandage or handkerchief passing the top of the shoulder, and tied r the opposite axilla; this assists ising the arm, which is also sup-d by an elbow-sling. Finally, a ortable poroplastic or leather is fitted over the shoulder and ed on. Union generally occurs out six weeks, but often results in great stiffness, unless massage manipulation are suitably employed; they must commence, how-a little later than in the simpler cases mentioned above. At he splints, etc., are restored to position after the daily rubbing, re gradually discarded, so that by the end of three weeks or so m is merely supported by a sling. When the head of the bone een totally dislocated from the glenoid cavity, operative treat-is often advisable; in some cases the fragment is best excised, others an attempt to replace and fix it to the shaft of the us should be made; to this end a useful hook for fixing into and ulating this upper fragment has been devised by McBurney.

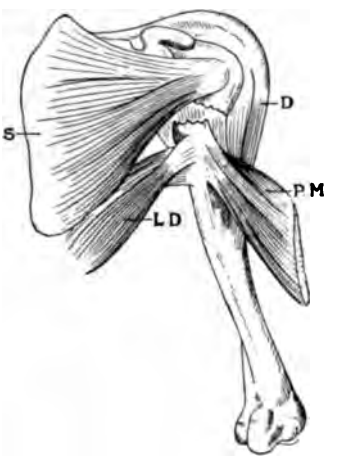


FIG. 160.—FRACTURE OF SURGICAL NECK OF HUMERUS.

S, Subscapularis; L.D., latissimus dorsi; D, deltoid; P.M., pectoralis major.

racture of the Surgical Neck, the 'Extracapsular Fracture' VIII.). The bone yields in this case below the muscles d to the tuberosities, but above the insertions into the bicipital

groove and its margins of the latissimus dorsi, pectoralis major, teres major. It results from violence applied directly below the of the shoulder, or from falls on the hand or elbow. The fract more or less transverse, and the displacement a double one; the fragment is rotated outwards, and generally adducted by the m inserted into the tuberosities, especially the subscapularis; whil lower fragment is drawn inwards by those attached to the bic groove, and upwards by the deltoid, coraco-brachialis, biceps, triceps (Fig. 160). The appearance of the patient is sufficiently acteristic; the head of the bone is still in the glenoid cavity, s there is no loss of the fulness of the shoulder (Fig. 161, C), alth there is a depression just below, unless it is obliterated by the exte hæmorrhagic effusion. The elbow is directed away from the sid

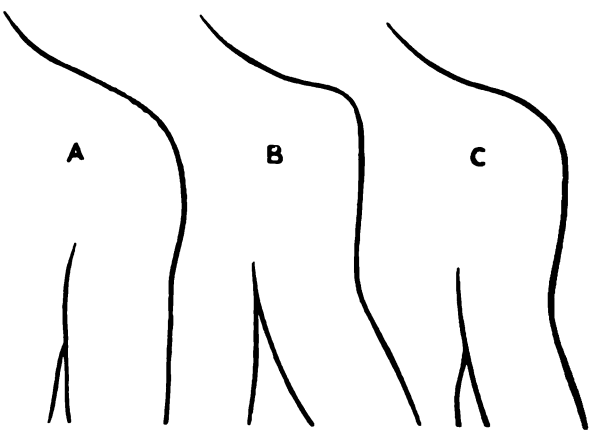


FIG. 161.—OUTLINES OF SHOULDER.

A, Normal shoulder; B, dislocation of shoulder; C, fracture of surgical of humerus.

the axis of the lower fragment is upwards and inwards. Crepit be obtained by extending and rotating the arm, which is short inch or more. This fracture is often very painful from pres the upper end of the lower fragment against the brachial nerv impaction occurs, the signs are much less evident, and, inde be very equivocal; the lower fragment is usually driven upper, and only slight shortening or displacement may be pre

Complications. The axillary vessels may be seriously dam more commonly some of the nerves sustain injury, especi circumflex, which winds round the neck of the bone close to of the fracture.

Treatment.—Immobilization of the fragments is absolutel sary in this fracture. It may be secured by the applicatio axillary pad and a shoulder-cap, whilst the arm is kept to t and the hand supported by a sling. The elbow should be all

lang to overcome the shortening. Middeldorpf's triangle (Fig. 163) may be used with advantage in this fracture. Firm union usually results in four and a half to six weeks, but with the formation of a good deal of callus; massage and passive manipulations should be daily employed from the third week onwards, the apparatus being taken off for the purpose and re-applied, if necessary.

3. **Separation of the Upper Epiphysis** occurs up to the age of nineteen to twenty years, and involves the head and both the tuberosities. The upper end of the shaft is somewhat conical in shape, the apex of the cone fitting into a depression in the middle of the epiphysis (fig. 162). The lesion usually follows the line of the cartilage; but displacement is often incomplete, partly from the conical projection acting against the inner edge of the epiphysis (a doubtful occur-

FIG. 162.—SEPARATION OF THE UPPER EPIPHYSIS OF THE HUMERUS.

rence), but mainly from the persistence of a well-marked periosteal sleeve or bridge on the outer and posterior side. The shaft usually travels forwards, its upper end projecting so as to be felt or even seen beneath the skin an inch or more below the acromion; occasionally a well-marked inward displacement is superadded, so that the condition somewhat resembles a subcoracoid dislocation. The presence of the head of the bone in the glenoid cavity should prevent this mistake, whilst the softness of the crepitus distinguishes it from a fracture.

Treatment.—It is most important to reduce this displacement, since otherwise interference with the growth of the limb is almost certain to occur. This may be effected by traction upon the arm under an anæsthetic, assisted perhaps by slight rotary movements or abduction; should these manœuvres not be successful, it is quite permissible to open the joint antiseptically, and restore the parts to their correct position. After reduction the limb is treated as for a fracture of the

neck. Should union occur in the displaced position, consi
limitation of movement results from the projecting edge of t
physis; this may be improved by cutting down and chiselling it

4. The **Great Tuberosity** is occasionally torn off as a result o
or muscular violence, or as a complication of fracture through th
If the whole tuberosity is separated, there is marked deformity,
ing in a great increase in the breadth of the shoulder. The fr
is displaced upwards and backwards by the unopposed action
supra- and infra-spinatus, whilst the shaft of the humerus is
forwards and partially dislocated (or subluxated) by the subsca
and other muscles. A distinct sulcus is felt between the tw
masses, and if they can be brought together, crepitus is obtained.

ment.—There can be no question that when displacement has oc

FIG. 163.—MIDDELDORPF'S TRIANGLE FOR FRACTURED HUMERUS
For the sake of clearness, the bandages, etc., have been represented s
smaller than would be the case in the living subject; a Gooch spl
also with advantage be applied to the fore-arm.

the most efficacious plan is to cut down on the fragment and fi
position by wire, screw, or peg. Excellent results follow, if
is maintained. Failing operative treatment, the patient must l
in bed, with the arm elevated and extended, supported by pill
most uncomfortable position—until union has occurred. Fail
accurate diagnosis, the case will probably be treated by appl
axillary pad and keeping the elbow to the side; the fragment
be approximated in this way, and the result will be defective
and a weak arm, which often remains permanently crippled in
massage and galvanism.

Fractures of the Shaft of the Humerus may arise from any f
violence, whether direct or indirect, and even from muscular vi

as *e.g.*, in throwing a cricket-ball. The signs of the injury are very obvious, and most typical. The displacement depends largely on the position of the fracture. If it occurs above the insertion of the deltoid, but below that of the muscles inserted into or around the bicipital groove, the upper fragment is drawn inwards, and the lower upwards and outwards. If, however, it is below the deltoid, the upper fragment is drawn outwards, and the lower upwards and inwards. As the line of fracture approaches the elbow, the displacement tends to become more antero-posterior than lateral, owing to the change in shape of the bone. The most common complication is injury to the musculo-spiral nerve which winds round the shaft close to its centre.

Treatment.—An internal angular splint reaching from the axilla to the wrist must be applied, together with three small lateral splints to fix the fragments, or a piece of Gooch or kettle-holder splint; the limb is kept to the side in a sling. Union is usually complete in five weeks.

It is not at all uncommon to meet with an ununited fracture of the shaft of this bone: this is probably due, not to any anatomical reasons, but simply to the fact that the necessity for fixing and supporting the elbow-joint has not been appreciated, the fore-arm being allowed to hang loose on the false plea of tending to diminish the shortening.

A very useful appliance for all fractures of the humerus is the Middeldorpf triangle (Fig. 163). It is carefully padded so that the angles and edges are protected, and applied so that its base is in contact with the body-wall and its obtuse-angled apex in the elbow. It is fixed by a strap or bandage passed from the axillary angle over the same shoulder and under the opposite axilla, as also by a sheet or bandage round the trunk. Pieces of Gooch splinting can be applied to the arm, thus completely immobilizing the humerus, and the fore-arm is also fixed. The fingers are left free, or if there is any swelling they are bandaged. This apparatus is even more efficacious when the patient is standing than when he is recumbent.

Fractures of the Lower End of the Humerus.—In dealing with any injury in the vicinity of the elbow, it is absolutely essential that the relative position of the bony points, which can there be felt, should be accurately established, and a comparison made with those of the opposite side. Normally four bony prominences can be detected, viz., the two condyles, the olecranon, and the head of the radius. The relation of the olecranon to the condyles varies with the position of the elbow. If the fore-arm is extended, the tip of the olecranon just touches the intercondyloid line, but is placed nearer the inner than the outer condyle, whilst in flexion of the fore-arm it lies below that line. The head of the radius in all positions of the arm is immediately below the outer condyle, and can be felt rotating beneath a dimple in the skin which appears at that spot. When the arm is flexed to a right angle, the tip of the olecranon is a little in front of the posterior surface of the upper arm, so that a ruler placed along that surface misses the olecranon; this is a useful guide in ascertaining if the bones of the fore-arm have been displaced backwards or forwards.

Another important feature depends on the fact that the axis of the

es not correspond with that of the arm, the former be
on of slight abduction (about 15°), constituting wh
the 'carrying angle' (Fig. 164, A). Lateral devi
fractures in the neighbourhood of the elbow resul
ions of this angle, and if these are allowed to persist
f cubitus varus or valgus (Fig. 164, B, C) ensue,
terfere with the utility of the limb.

ansverse Supracondyloid Fracture, involving the shaft
nches above the joint, is due either to a fall on the ha
n bent, when the lower fragment is usually displace
, or much less commonly to a fall on or violence direct
of the elbow, when the displacement is either forwards

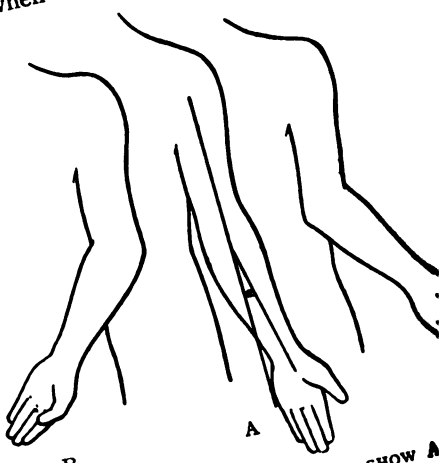
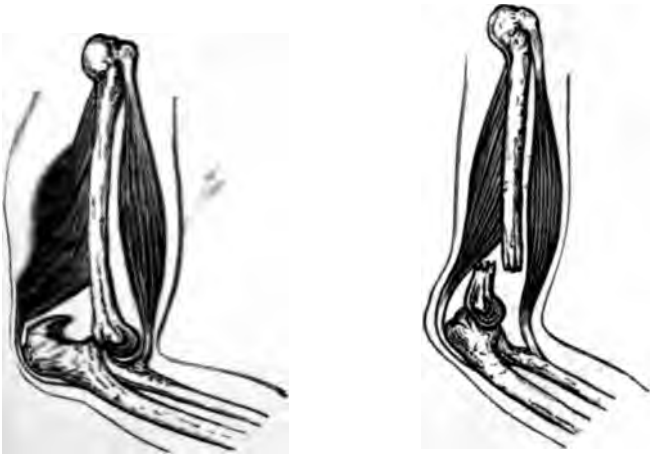


FIG. 164.—OUTLINES OF UPPER EXTREMITY TO SHOW A
ANGLE ($a = 15°$); B, CUBITUS VARUS; C, CUBI

wards. When the lower fragment is displaced
drawn up by the action of the triceps upon the
amount of angular as well as vertical deformity
when displaced forwards, apparent lengthen
results, with a loss of prominence of the olec
these conditions is likely to be mistaken fo
bones backwards at the elbow (*cf.* Fig. 165,
recognised by the following facts: (*a*) The
bony points at the elbow is unimpaired; i
necessarily disturbed. (*b*) The length of th
tubercle which can be easily felt at the ba
outer condyle is diminished in a fracture,
dislocation. (*c*) The forward projection
upper fragment is felt above the crease o
location it corresponds with it. (*d*) The

a crepitus, but readily reappears; in a dislocation the bones are placed with difficulty, but after replacement they usually remain in position. It may be difficult and at times almost impossible to recognise this condition at once, owing to the amount of swelling and ecchymosis present; the application of a cooling lotion for a few days will so reduce this as to permit a thorough examination, and this is most essential, as a wrong diagnosis probably leads to bad treatment and much subsequent impairment of function of the limb. Skiagraphy will, however, determine the nature of the lesion without delay. Lateral deviation sometimes occurs, and the restoration of the normal 'carrying angle' must always be aimed at.

Much care is needed in the **Treatment** of these cases in order to prevent ankylosis or deformity, and the stereotyped application of an



A B

FIG. 165.—FRACTURE OF LOWER END OF HUMERUS (B) COMPARED WITH DISLOCATION OF RADIUS AND ULNA BACKWARDS AT ELBOW (A). (TILLMANNS.)

internal angular splint is by no means sufficient. To correct the backward deformity the elbow must be flexed, and traction made upon the fore-arm, which is placed in a position of full supination. It may then suffice to apply an anterior angular splint in the bend of the elbow, and a straight posterior splint reaching below the tip of the olecranon, so as to keep it well forwards; or perhaps it would be better to apply a carefully-moulded gutter-shaped posterior splint reaching well above and below the elbow, and a shorter anterior splint fitting down to the bend of the joint. In these fractures the elbow-joint is not as a rule involved, and therefore passive movement is not commenced too early for fear of deformity, owing to yielding of the callus. At the same time, it must not be delayed too long, as if the olecranon and coronoid fossæ are involved, they become occupied by callus, and if this is allowed to consolidate, the movements of the

arm will be subsequently limited. In displacements of the bon wards an anterior angular splint should be employed, and post short posterior one in addition.

2. **Separation of the Lower Epiphysis of the Humerus** is a common accident in children. At birth and for some years after the epiphysis consists of a single mass of cartilage, including th condyles as well as the articular surface, and these are all invol any separation, together possibly with a fragment of the dia (Fig. 166). As, however, growth and ossification proceed, the encroaches rapidly upon the inner portion of the epiphysis, so th

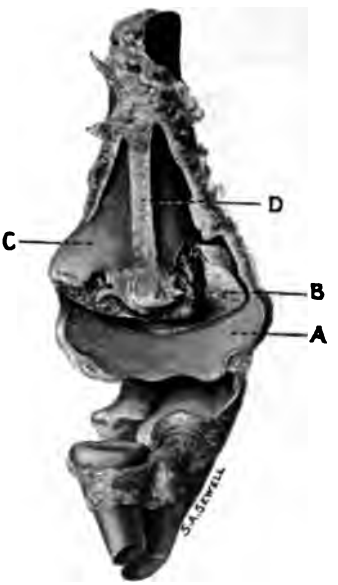


FIG. 166.—SEPARATION OF THE LOWER EPIPHYSIS OF THE HUMERUS IN AN INFANT UNDER THREE YEARS. (MUSEUM OF ROYAL COLLEGE OF SURGEONS.)

A, Epiphysis, including both condyles; B, small portion of the diaphysis detached with epiphysis; C, diaphysis; D, loose periosteal bridge.

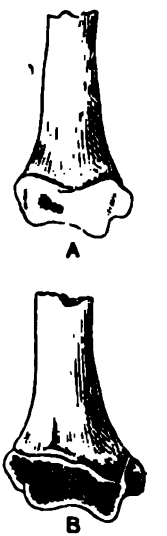


FIG. 167.—A AND B, LOWE OF THE HUMERUS AT YEARS AND FIFTEEN YE AGE. (SEMI-DIAGRAM AFTER QUAIN'S ANATOM

In A there is only one o ossification; in B all the in the lower epiphysi joined together with the tion of that for the l condyle.

epiphyseal line becomes almost rectangular (Fig. 167), the in condyle being isolated from the rest of the epiphysis. As a re this, separations of the epiphysis after puberty do not inclu internal condyle; the accident at this period is situated rel much nearer the joint than in infants, and consequently is more to be followed by impairment of movement. The displacem

PLATE IX.

TION OF THE LOWER EPIPHYSIS OF THE HUMERUS, WITH DISPLACEMENT WARDS, IN A YOUNG PERSON A LITTLE OVER THE AGE OF PUBERTY.

er condyle has been broken off, as well as the epiphysis, and displaced urds and outwards; above this fragment is seen a shadow caused by the ping up of the periosteum. The ulna and radius accompany the lower ysis of the humerus outwards.

generally backwards, with some amount of lateral displacement or deviation (Plate IX.). **Treatment.**—Reduction can usually be accomplished by flexion, and the application of antero-posterior splints may suffice to maintain the fragment in position; but it is an open question whether it is not wiser, at any rate in small children, to avoid splints and trust to full and complete flexion alone, the hand being bandaged down to the shoulder on the same side. Passive movements should commence from about the eighth day.

3. Fracture of the **Condyles** usually results from direct injury, though the outer is sometimes broken by indirect violence, such as a fall on the hand, since the laxity of the elbow-joint on this side allows considerable mobility between the radial head and the capitellum of the humerus. Fracture of the **external condyle** always involves the elbow-joint, and is more common than that of the inner. The line of fracture runs from the condylar ridge downwards and inwards so as to separate the capitellum, or even encroach upon the trochlear surface. The fragment is but little displaced, and can be felt to move on the rest of the bone with crepitus, which may also be produced by rotation of the hand and radius. The accident is associated with much pain and ecchymosis. Fracture of the **internal condyle** may be intra- or extra-capsular. The *extra-articular* variety (Fig. 168) consists of a mere displacement of the tip of the condyle (or epicondyle), probably a separation of the epiphysis, since it occurs mainly in children. The small fragment is drawn a little downwards by the muscles attached to it, and the fracture is readily detected by the usual signs; it may be associated with injury of the ulnar nerve. The *intra-articular* form is the more common, and extends from the condylar ridge to the trochlear surface, implicating the coronoid and olecranon fossæ. The fragment is displaced a little upwards and backwards, the ulna usually accompanying it, so that on extending the elbow the olecranon appears unduly prominent, the lower end of the humerus projects anteriorly, and the fore-arm is slightly adducted (cubitus varus). The ulnar nerve may also be injured in this case.

FIG. 168. - FRACTURES OF INTERNAL CONDYLE AND EPICONDYLE OF HUMERUS. (TILLMANNS.)

Treatment.—Flex the fore-arm and place it on an angular splint, using a pad and strapping to maintain the fragments in position. If the joint has been involved, passive movement should be started early to avoid subsequent stiffness. Possibly in some cases it would be wiser to apply no splints, and treat the fracture by early massage, whilst in others it may be better to operate and fix the fragment by wire or screw.

4. **T- or Y-shaped Fracture** usually occurs as the result of direct injury. A fissure extends into the joint between the condyles, and

may bifurcate above so as to detach partially or completely the condyles, or it may be connected with a transverse supracondy fissure, constituting the T-shaped variety. If the fragments are totally detached, there will be much bruising and pain, but no crepi but if the fragments are separated, the condyles will move on e other with crepitus, and the elbow will be widened with n deformity. In these cases the joint is very likely to become s owing not only to adhesions within it, but also to the filling up of fossæ in the lower end of the humerus with callus. Excess of viol leads to comminution, and luxation of the bones of the fore-arm s also occur. A marked feature of these cases is the rapidity v which swelling supervenes, owing to hæmorrhage into and around joint, rendering accurate diagnosis difficult apart from skiagra **Treatment** must be directed towards reducing the swelling, and t after manipulating the fragments into as good a position as possi antero-posterior angular splints are applied, and passive mo started early. In some cases incision and fixation of the fragm are indicated, in others excision of the end of the bone.

Fractures of the Ulna.—1. The **Olecranon** is frequently broken direct violence, the patient falling on the bent elbow, but occasion by muscular action. The line of fracture usually runs through base of the process at its attachment to the shaft, and is for the s part transverse. Should the tendinous and periosteal covering the bone remain intact, there is but little separation; but if fracture is complete, the detached fragment is drawn up by the tric and tilted backwards (Plate X.), whilst the bones of the fore-arm subluxated forwards. Great swelling in and around the joint co on early; on examination, the detached fragment can be readily tinguished, and between it and the shaft a sulcus, which increase flexing and diminishes on extending the fore-arm. The nature of union depends on the amount of separation of the fragments, and treatment adopted. If the fragments are not brought accurately apposition, fibrous union will occur, and although the new cicatri tissue may stretch considerably, a useful elbow sometimes res in some cases the fragment is drawn up and fixed to the humo and a false joint is developed below it. If, however, the fragm are brought in contact, bony union follows, though even then s impairment of function may ensue owing to the callus encroac on the articular surface, which is always involved. In all cases ulnar nerve is exposed to injury.

Treatment.—The most satisfactory plan consists in laying parts freely open, clearing the joint of all blood-clot, removing sl of tendon which may be placed between the fragments, and wiring them together, the wire just extending down to the artic cartilage (Plate XI.). The same precautions and after-treatm must be followed as in dealing with the patella. A similar should be adopted in all compound cases, and in those where l fibrous union has occurred with a resulting weak and relaxed ell in the latter instance the new fibrous tissue must be entirely

PLATE X.

FRACTURE OF OLECRANON BEFORE OPERATION.

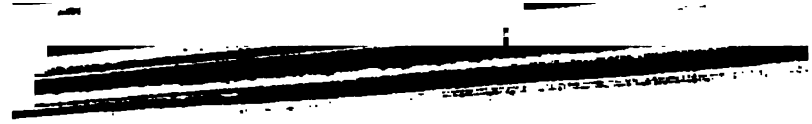


PLATE XI.

ACTURE OF OLECRANON TWO WEEKS AFTER OPERATION.
ime patient as Plate X. It will be noted that, though the fragments are in apposition, they are not united.

PLATE XII.

FRACTURE OF OLECRANON (SIX WEEKS AFTER OPERATION)
From the same patient as Plates X. and XI. The fragments are now united by bone.

sected away and the bony surfaces freshened. If an operation is not undertaken, the arm should be put up on a straight anterior splint, the fragment being drawn into position as well as possible by means of a pad and figure-of-8 bandage. Gentle passive movement and massage should commence at the end of a fortnight.

2. The **Coronoid Process** is so deeply placed and so well protected that fractures must necessarily be very uncommon, except as an accompaniment of dislocation of the ulna backwards. The signs relied on in making a diagnosis are that reduction of the dislocation is easier than usual and associated with crepitus, and that the deformity is likely to recur. The **Treatment** consists in apposing the bony surfaces, if possible, by flexing the fore-arm. Bony union is, however, less important than a freely moveable elbow, and therefore passive movement is commenced early.

3. The **Shaft of the Ulna** is often fractured by itself as a result of direct violence, to which its exposed position renders it peculiarly liable. Fracture also occurs as a complication of several of the forms of dislocation of the radius alone (Plate XXVIII.). The superficial position of the posterior border renders examination of the bone easy; if displacement or a breach of substance occurs, it is readily detected, but when merely a fissure exists, it is not so easy to make out. The constant pain referred to one spot, the slight mobility, and possibly crepitus, indicate the character of the lesion. No longitudinal displacement can occur if the radius remains intact, and under such circumstances the only deformity consists in a slight drawing forwards of the upper fragment by the brachialis anticus, whilst the lower fragment is approximated to the radius by the pronator quadratus. **Treatment.**—The arm is placed midway between pronation and supination, the deformity corrected, and the limb kept at rest between anterior and posterior splints, or in plaster of Paris.

4. The **Styloid Process** may be detached by direct violence, or as a complication of fracture of the lower end of the radius. The displacement may be considerable and very evident, being governed by the direction of the violence. **Treatment** consists in replacing the fragment by manipulation, and fixing it by adhesive plaster; an anterior splint is applied with the hand adducted.

Fractures of the Radius—1. The **Head of the Radius** may be broken alone, but more usually such an accident is associated with other injuries to the elbow, as, for instance, fracture of the outer condyle or some form of dislocation. The upper epiphysis may be separated, or there may be merely a transverse or vertical fissure; but under any circumstances the displacement is slight if the orbicular ligament remains intact. In complete separation the head is immoveable, and crepitus is produced when the arm is rotated; bony union usually follows, with more or less impairment of function, but sometimes the head, or a portion of it, remains detached as a loose body in the joint. **Treatment.**—The limb must be kept at rest for a short time midway between pronation and supination, and early

passive movement instituted. Excision of the head may be required for comminution, or for limitation of movement due to excessive formation of callus.

2. The **Neck**, *i.e.*, the portion between the orbicular ligament and the biceps tuberosity, is occasionally broken. The lower fragment is drawn upwards and forwards by the biceps, causing a bony projection on the front of the elbow, especially evident on attempting to flex the joint, whilst the fore-arm is pronated with loss of the power of rotation, and the head of the bone does not accompany the shaft on passively rotating it. **Treatment.**—The arm is flexed to relax the biceps and supinated, and the limb placed on a posterior angular splint, with a pad over the front of the lower fragment. Passive movement should not be commenced too early, as the lesion is extra-articular, and the biceps may produce permanent deformity if allowed to act upon unconsolidated callus.

3. The **Shaft** of the radius is broken either by direct violence or by falls on the palm; the latter accident, however, rarely causes fracture except at the lower end. The signs are sufficiently evident, owing to the superficial position of the bone, consisting of localized pain and loss of power of active rotation, whilst passive rotary movements are accompanied by crepitus, the head of the bone and upper fragment remaining immobile below the outer condyle unless impaction is present.

The *displacement* is somewhat characteristic. If the fracture is situated *above the insertion of the pronator teres*, the upper fragment is flexed and fully supinated by the action of the biceps and supinator brevis, whilst the lower fragment is drawn towards the ulna and fully pronated by the unopposed action of the two pronator muscles. **Treatment.**—Inasmuch as it is practically impossible to command the small upper fragment, the lower must be brought into apposition with it by fully supinating the fore-arm and hand after flexing the elbow, and applying a posterior splint, the patient being preferably kept in bed for a time and the arm laid on pillows. It may afterwards be supported in a hollow leather splint carried across the body, and with the palm directed upwards.

When the fracture is placed *below the insertion of the pronator teres*, the upper fragment is drawn forwards by the action of the biceps and inwards by the pronator, assuming a position midway between pronation and supination; the lower fragment is approximated to the ulna partly by the direct action of the pronator quadratus, partly by the supinator longus tilting the upper end inwards; the hand is pronated looking downwards. Union to the ulna by callus thrown across the interosseous space is not unlikely to occur. Treatment by anterior and posterior splints may here be adopted, with a good deal of osseous pad interposed between the limb and the splints, the hand being placed midway between pronation and supination, and the limb fully adducted.

4. The **Lower End of the Radius** is broken with extreme frequency, constituting what is known as **Colles's Fracture.** This injury occurs

PLATE XIII.

CTURE OF SHAFT OF RADIUS (ANTERO-POSTERIOR VIEW).

PLATE XIV.

FRACTURE OF SHAFT OF RADIUS (LATERAL VIEW).

On the same patient as Plate XIII., and showing excellently the necessity for taking skiagraphs from two points of view.

PLATE XV.

's Fracture: a Simple Case, without much Lateral Displacement of Hand.

PLATE XVI.

URE: A BAD CASE, WITH THE STYLOID PROCESS OF THE ULNA
OFF AND MUCH OUTWARD DISPLACEMENT OF HAND.

PLATE XVII.

193. View of Colles's Fracture, showing Displacement Backwards and Upwards of the Lower Fragment.

most commonly in women of advanced years, although it may happen at any age or to either sex. It is almost invariably due to falls upon the outstretched palm, when the hand is completely pronated and extended. The line of fracture is placed about 1 inch from the wrist, though rather under than over this. It is usually transverse, but occasionally oblique in an antero-posterior direction, sloping from above downwards and forwards, so that the fracture is nearer the wrist-joint in front than it is behind, and also not uncommonly oblique laterally, slanting from without downwards and inwards (Plate XV.).

The *displacement* is somewhat complicated. (*a*) The lower fragment is carried backwards and a little upwards (Plate XVII.), a condition resulting from the direction of the violence, viz., a fall on the palm of the outstretched hand, the radius being thus compressed between the ground and the weight of the body, and yielding at what is evidently a weak spot; this deformity is maintained by the action of the radial extensor muscles of the wrist, and often by impaction of the fragments. (*b*) From the fact that the main violence is received by the ball of the thumb, owing to the extreme pronation of the hand, the outer side of the lower fragment is displaced more than the inner, which, moreover, remains fixed to the ulna by the strong inferior radio-ulnar ligaments. This position is in part kept up by the tension of the extensors of the thumb and the supinator longus, but mainly by impaction of the fragments. The hand and carpus always follow the lower fragment, and hence the former becomes markedly abducted, causing the styloid process of the ulna to become unduly prominent, and lower than that of the radius, whereas it is normally placed on a slightly higher level. In bad cases the styloid process of the ulna is actually torn off, or the internal lateral ligament ruptured, allowing displacement outwards of the whole hand (Plate XVI.). (*c*) The lower fragment is also rotated around a transverse axis, so that the lower articular surface looks backwards as well as downwards, a displacement due to the fact that in falling the force is directed, through the carpus, more to the posterior than to the anterior aspect of the bone. (*d*) The upper fragment is pronated and approximated to the ulna by the pronator quadratus muscle. The *deformity* produced by the fracture is therefore very characteristic. The hand is in a position of radial abduction, and usually pronated, with the fingers somewhat flexed (dinner-fork deformity). Three abnormal osseous projections are present: (i.) The styloid process or head of the ulna is very marked, owing to the radial abduction of the hand (Fig. 170); (ii.) on the back of the wrist is a prominence which terminates abruptly above, caused by the projection of the lower fragment (Fig. 169); and (iii.) corresponding to this dorsal projection there is a well-marked depression on the palmar surface, and above it a less sharply-defined swelling, which gradually shelves into the fore-arm, due to the upper fragment. Pronation and supination are lost, and, as a rule, there is neither crepitus nor preternatural mobility, owing to impaction of the fragments. In doubtful cases help in diagnosis may be obtained by

observing the relative position of the two styloid processes; normally, that of the radius is well below that of the ulna, but in cases of fracture the ulnar projection is below that of the radius.

As already stated, the fracture is commonly impacted, the upper fragment being firmly driven into the cancellous tissue of the lower end; excess of violence may, however, disimpact, but often at the expense of comminution of the lower fragment. Union is effected without difficulty, but the patient should always be warned at an early date to expect some deformity about the wrist, as well as considerable impairment in the subsequent mobility of the fingers and hand, owing partly to adhesions in the joint, partly to blood trickling down the tendon sheaths and fixing the tendons.

Treatment.—To reduce the deformity, extension and manipulation are both needed. The patient should be seated on a chair, and the

FIG. 169.—COLLES'S FRACTURE: LATERAL VIEW.

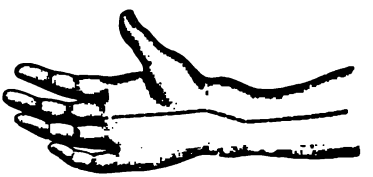


FIG. 170.—COLLES'S FRACTURE: PALMAR VIEW. (TILLMANNS.)

surgeon, standing in front, should grasp the hand firmly, using the right hand for fractures on the right side, and the left for those on that side. Counter-extension is made from the flexed elbow, and the hand is then forcibly extended and adducted; disimpaction is thus brought about, and a little manipulation enables the fragments to be moulded into position.

Many plans have been adopted in the application of splints for this fracture: (1) A piece of *Gooch splint* is perhaps the most simple and efficacious. It is shaped so as to cover the radius front and back as far as the middle line of the arm, and extends nearly from the elbow to the front and back of the knuckles of the index and middle fingers; its lower end is hollowed out in a horseshoe manner, so as not to reach beyond the end of the metacarpal bone of the thumb. This is well padded and firmly bandaged on; it grasps the radius and steadies the hand in a position of adduction, without in any way interfering with the movements of the fingers. (2) *Carr's splint* (Fig. 171) consists of two shaped pieces of wood fitting the front and back of the radial side of the fore-arm, whilst to the palmar one is attached an oblique rod to be grasped by the fingers, and thus the hand and wrist are maintained in a position of adduction, whilst the fingers can be freely moved. (3) The *Pistol splint* consists of a straight portion fitted to the front of the fore-arm, whilst the hand-piece is bent at an angle like the butt-end of a pistol. It may also be applied to the back of the fore-arm, together with a short straight splint on the palmar aspect reaching to the wrist. It keeps the

hand and arm in excellent position, but is objectionable because the ngers are also restrained. If, however, it is shortened at the end four or five days so as not to extend beyond the knuckles, it may used without doing harm. (4) Two straight splints may be ap- ed to the front and back of the fore-arm, which is kept midway tween pronation and supination; neither should extend beyond knuckles, so that the fingers are free. The weight of the hand, en the arm is slung, keeps it in a position of adduction.

Union is usually firm enough in a fortnight to permit the removal the splints, the arm being kept in a leather or guttapercha sup- t for some time longer. Massage and passive movement should employed after the first week, and the fingers left free and rcised after the first day or two.

Separation of the Lower Epiphysis of the radius occurs in young ple under twenty, and, when the lower fragment is displaced kwards, simulates somewhat closely a Colles's fracture. The er end of the diaphysis projects anteriorly to a much greater

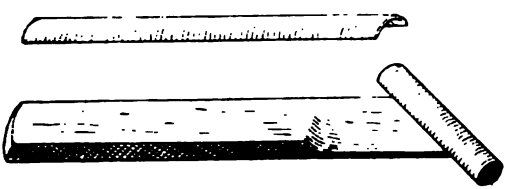


FIG. 171.—CARR'S SPLINT FOR COLLES'S FRACTURE OF LEFT HAND.

tent, and, indeed, may protrude through the skin of the wrist. e lower end of the ulna may be involved in the accident, either epiphysis being separated, or the shaft broken a little above. is condition may be mistaken for a backward dislocation of the ist, but a diagnosis can be readily made by observing the relative ition of the styloid processes to the carpal bones. Lateral dis- cement occurs in some cases (Fig. 172). **Treatment** is practically same as for Colles's fracture.

Should arrest of growth result from this accident, the hand retains connection with the stunted radius, but the ulna continues to w downwards, and its lower end is found on the inner and terior aspect of the carpus, which is pushed *en bloc* towards the ial side, but without any marked abduction.

Fracture of both Bones of the Fore-arm may result from direct or irect violence, but more commonly from the former. Any part he bones may yield, but the middle and lower thirds are most uently affected, owing to their greater exposure. The line of ture may be transverse or oblique, and the displacement varies with this and with the force employed. Occasionally both es are broken close to the wrist by a fall on the palm of the

hand (Plate XVIII.). The upper fragments are usually drawn together and pronated, whilst the lower end of the radius is drawn up by the supinator longus. The diagnosis of these fractures is very simple, since there is, as a rule, obvious deformity. **Treatment** consists in reduction by extension conjoined with manipulation, and the application of splints which will prevent cross-union of the bones. If the fracture is above the insertion of the pronator teres, the arm must be put up in full supination, as suggested for a similar fracture of the radius alone (p. 512), whilst below that spot the usual position midway between pronation and supination may be allowed. Union is generally complete in five or six weeks.

FIG. 172.—SKIAGRAM OF DISPLACEMENT OF LOWER EPIPHYSIS OF RADIUS AND OF THE HAND OUTWARDS.

Fractures of the Metacarpal Bones and Phalanges are not uncommon, particularly in the third and fourth fingers, being due to direct violence, and hence usually transverse. There is generally but little displacement, though occasionally the fragments may overlap, whilst a certain amount of localized swelling and tenderness is always noted. The treatment usually required is immobilization for a short time, and for the phalanges a small zinc splint moulded along the front of the finger acts admirably. Should the fragments overlap, operation may be necessary (see Plates XIX. and XX.).

Bennett, of Dublin, has described an interesting fracture of the first metacarpal (*stave of the thumb*), which is due to indirect violence, and not very rare. The line of fracture is oblique, separating the anterior portion of the base, which remains *in situ*, from the rest of the shaft, which is drawn upwards and backwards, so as to lie behind the trapezium. Should the displacement be overlooked, the bone unites in

PLATE XVIII.

E OF BOTH BONES OF THE FORE ARM, WITH DISPLACEMENT OUTWARDS

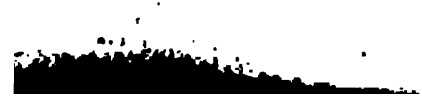
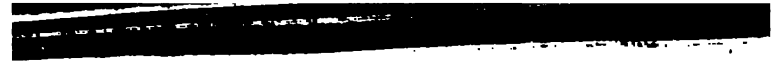


PLATE XIX.

THE FOURTH AND FIFTH METACARPALS EIGHT WEEKS AFTER THE INJ. THE FOURTH METACARPAL THE FRAGMENTS OVERLAP, AND ABSENCE THE FINGER IS SHORTENED, AND THE LINE OF THE IRREGULAR.

PLATE XX.

OF SAME HAND AS PLATE XIX. FOUR WEEKS AFTER OPERATION (OSE) THE FOURTH METACARPAL IS NOW STRAIGHT, AND THE KEPT IN APPOSITION BY SILVER WIRE. THE UNION WAS FIRM, H THE CALLUS WAS STILL INVISIBLE BY SKIAGRAPHY. THE LENGTH E FOURTH FINGER IS PRACTICALLY NORMAL.



this position, and the deformity, which persists, determines weakness and disability of the thumb. **Treatment.**—The fracture is reduced by traction. A poroplastic splint is moulded to the anterior (palmar) aspect of the thumb, reaching above the wrist; it is first fixed to the distal end by strapping, and then bandaged above, so that extension is continuously applied.

Skiagraphy has demonstrated that many 'sprains of the wrist' are in reality due to fracture of a carpal bone, and of these a transverse fracture through the waist of the scaphoid is perhaps the most common. As a rule, rest and subsequent massage are alone required; but occasionally movement is impaired by a displaced fragment, and then its removal is necessary.

Fractures of the Pelvis.

Fractures of the pelvic bones are almost always the result of direct injury, such as blows, gunshot wounds, and railway, carriage or cart accidents. For convenience they may be described under the following headings:

1. **Fractures of the False Pelvis.**—A portion of the crista ilii may be broken off, or the anterior or posterior spines separated, or merely a fissure in the bone produced. But little importance attaches to such conditions, as the displacement can never be great, although a portion of the crest may be drawn down by the glutei muscles, or the anterior superior spine displaced by the sartorius; in severer cases, when the bones are crushed and comminuted, the true pelvis is also likely to be affected, and more serious consequences may then arise. Considerable pain is always produced by these conditions, especially on any vigorous respiratory movements. Union occurs readily if the patient is kept quiet in bed with the shoulders raised, and the legs supported to relax the muscles. A flannel bandage round the pelvis gives comfort and support.

FIG. 173.—FRACTURE OF THE PELVIS. (BRYANT.)

2. **Fracture of the True Pelvis** is a much more serious accident. The line of fracture usually runs into the obturator foramen, and may detach both the horizontal ramus of the pubes and the ascending ramus of the ischium from the rest of the innominate bone (Fig. 173). This is frequently conjoined with a fracture through the sacro-iliac synchondrosis either on the same or opposite side, but more frequently the latter; whilst a double fracture, front and back, may also occur at these, the weakest, points. The cause of the posterior fracture is that,

when the pelvic ring has yielded anteriorly from the violence, the
tinued strain, whether directed from the front or from the sides,
necessarily fall on the part where the ilium is most closely conn
with the sacrum, and the bones then give way rather than the
yielding and powerful sacro-iliac ligaments. The **Symptoms** are t
of shock and pain in and around the pelvis, especially on movem
of the legs or on coughing. There may be local ecchymosis and te
ness over the pubic ramus, and the patient either cannot stand, or
as if he were falling to pieces on attempting to do so. There is n
any deformity, although occasionally such an occurrence is n
Crepitus may be elicited on grasping the iliac bones, and moving t
one on the other; but such a method of investigation must be
sparingly indulged in. Complications frequently arise from inju
the internal viscera, especially the bladder, rectum, urethra, or va
as indicated by hæmorrhage into or from these organs. An as
catheter should be passed as a routine proceeding, and tied in i
urine is blood-stained.

Treatment.—The patient should be moved with the greatest
for fear of producing or increasing visceral complications. He i
to bed, and any obviously displaced fragments reduced, if practic
possibly under an anæsthetic. A broad flannel bandage shoul
applied, the knees tied together, and a leather or poroplastic
moulded to the pelvis. Visceral complications must receive atte
as indicated elsewhere. Union may be expected in about six w
but the patient should be kept in bed for at least eight, and even
only allowed to get about on crutches, wearing a padded belt.

3. **Fracture of the Acetabulum** is of two types: either the post
lip is broken off as a result of violence directed against it by the
of the femur, which is dislocated backwards by the same accide
a fall on the trochanter may cause a simple fissure extending in
across the cavity, or may resolve it into its three constituent elem
or may even drive the head of the bone into the pelvis. In the fo
case, the limb is in the position of a dorsal dislocation; this c
reduced without difficulty, and possibly with crepitus, but manif
great tendency to recur. Prolonged extension with a long spl
needed in such cases. In the latter class of injury a mere fissu
the acetabulum produces but few symptoms beyond a little pai
impairment of movement; but if the head of the bone is drive
the pelvic cavity, the symptoms are much more serious, on acco
the associated injuries to the viscera and the greater amount of vi
employed. The case will resemble one of fracture of the neck
femur, but there is usually only very slight mobility, and the h
the bone may be felt within the pelvis on rectal examinatio
attempt should be made to free the head of the bone, and th
treated as one of fracture of the neck of the femur; but a fatal
is very likely to follow.

4. **Fracture of the Tuber Ischii** results from falls in the
position. The diagnosis is often obscure.

5. **Fracture of the Sacrum** is always due to direct violence o

ble severity, such as kicks, blows, or gunshot wounds. It is frequently comminuted, and, from the associated injury to the sacral nerves, may result in loss of power of the bladder and . In a transverse fracture, the lower fragment is usually ed forwards, and may cause pressure upon the rectum; irregu- n the shape of the bone may be detected from within (*per* or from without. **Treatment.**—The lower fragment should aced, if possible; but considerable difficulty may be experienced ing it in position. A well-fitting pelvic band, with rest in bed, ably all that is necessary.

ractures of the Coccyx result from falls or blows, although its y often protects it from injury. Great pain is felt on walking, ny movement which increases the intra-abdominal pressure, s straining, coughing, defæcation, etc., since the coccygeus which is attached to this bone forms part of the pelvic gm. A rectal examination reveals preternatural mobility of er fragment, angular deformity, and perhaps crepitus. The **ent** consists in keeping the patient at rest until union has d; it is impossible to apply any apparatus, and hence the bone nite at an angle, causing pain, discomfort, and difficulty in tion. *Excision of the bone* is then required. The patient lies rone with the legs slightly flexed, or in the lithotomy position, ongitudinal incision is made in the middle line. The apex and margins of the bone are cleared, and the ligamentous tissues ; it to the sacrum divided by the knife; the bone is now laid by sequestrum forceps, and its remaining attachments severed, ecautions being taken not to encroach on the rectum. Two or titches are inserted, and also a drainage-tube for a few hours; essing is secured in position by a T-bandage. The bowels be confined for some days after the operation.

s upon the coccyx, unaccompanied by fracture, sometimes give a most severe and intractable type of neuralgia, known as ynia, which may quite prevent the patient from following his ions. If all the usual sedatives fail in giving relief, the bone e excised.

Fractures of the Upper End of the Femur.

Fractures of the Neck of the Femur may involve any portion of egion, but for clinical purposes are usually divided into those he head and those affecting the base near the trochanter.

cture of the Cervix Femoris near the Head (the so-called *intra-* variety, Fig. 174) is most frequently met with in persons of ced age, and especially in females. This is explained by the ic changes which take place in the cervix femoris of elderly . The spaces between the bony cancelli are enlarged and l with soft fat, whilst the ensheathing compact tissue is thinned, e 'calcar femorale' of Merkel (*i.e.*, the process of thick cortical

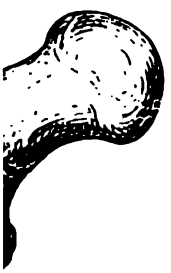
substance running from the lesser trochanter to the under part of the head) is atrophied. The neck of the bone is sometimes more horizontal than usual, and the head sinks below its usual position. Under such circumstances, it requires but little violence to produce a fracture, the direction of which varies according to the force applied. As a rule, the accident is due to some slight stumble or fall, such as slipping off the kerb or tripping upstairs; the bone yields in consequence, and the patient falls to the ground. The line of fracture may be transverse or oblique, and is mainly intracapsular. Some of the fibres reflected from the under surface of the capsule to the head of the bone may remain untorn at first, but later on they may give way from inflammatory softening, injudicious manipulation, or attempts to use the limb. The fracture is not usually impacted; if, however, this condition should occur, the upper end of the neck is driven into the loose cancellous tissue of the head. The *displacement* is necessarily limited entirely to the lower fragment, which is drawn upwards by the glutei, recti, and hamstring muscles, and rotated outwards and somewhat backwards, so that the fractured surface looks almost directly forwards.

FIG. 174.—FRACTURE OF THE CERVIX FEMORIS NEAR THE HEAD.

The *Method of Repair* in these cases depends to a large extent upon the general condition of the individual. If of a healthy temperament, and without any chronic pulmonary affection, so that he can be kept in the recumbent posture for six or eight weeks, bony union may certainly occur, in spite of the fact that at first synovial fluid finds its way between the fractured surfaces. The main process of repair takes place from the lower end, but little callus being formed from the head of the bone, the vascular supply being only just sufficient to maintain its vitality. If, however, the patient is feeble and weakly, and especially if the subject of chronic bronchitis and emphysema, the prognosis is by no means good, since hypostatic pneumonia and extensive bedsores may carry him off during the short stay in bed which is always necessary in order to relieve the more urgent symptoms of pain. Bony union is never, under these circumstances, to be expected, and a loose fibrous union, or even a false joint, is the best that can be looked for, the patient henceforth walking with the assistance of a stick or crutch. Not unfrequently the neck is absorbed and the shaft slips up on the dorsum ilii, the weight of the body being carried by the outer limb of the Y-ligament of Bigelow and the obturator internus tendon. The prognosis is, of course, much improved by the presence of impaction, and the fear of breaking this down must ever be in the mind of the examining surgeon; whilst the integrity

eriosteum and reflected fibres from the capsule also utlook.

amination has shown that a similar type of fracture of the neck *n and young people.* It is not unfrequently incomplete, and nding of the neck. The patient often recovers mobility of the k about after resting in bed for a few days; but the deformity ct, increases from further yielding of the softened bone, so that oxa vara results. A similar deformity follows a partial separa- epiphysis. A mistaken diagnosis of tuberculous coxitis may ne clearly appreciates the rapid appearance of the symptoms nd the facts that the trochanter is raised, the limb shortened, ts limited only in particular directions or not at all. If there is on, treatment is best carried out by fixation with plaster of ted position, and by prolonged freedom from the body-weight, callus to harden, as by the application of a Thomas's hip-splint.



CTURE OF CERVIX AR THE BASE. RAMMATIC FROM

FIG. 176.—FRACTURE OF NECK OF FEMUR NEAR THE BASE, SEEN FROM BEHIND. (COLLEGE OF SURGEONS' MUSEUM.)

The head and neck are depressed, and the trochanter major drawn slightly upwards.

he Cervix Femoris near the Trochanter (the so-called *cture*) always involves the hip-joint, since the capsule shaft of the bone along the anterior intertrochanteric no portion of the neck uncovered in this situation. ture is placed in front, either along the attachment of ig. 175) or well within it, and is really only extra- l; sometimes, moreover, the shaft itself is consider- l on. The great trochanter is often involved in the splintered or detached, and the lesser trochanter may a portion of the shaft, so that the bone is broken into fferent fragments (Fig. 176).

This fracture is usually the result of direct violence

acting transversely upon the trochanter major, as from a heav upon the hip. The posterior part of the neck, being weaker tha anterior, first gives way, being more or less crushed and commin the whole neck then yields, and the severed head and neck are fo impacted into the junction of the trochanter and shaft. The ma of these cases are thus primarily impacted, continuation of the vio producing disimpaction, coupled either with detachment of one or trochanters, or with comminution of the great trochanter. Disim tion may also follow at a later date from the rarefaction associated the early stages of repair or from injudicious manipulation.

The *displacement* is much the same as in the former variety upper fragment remains in the acetabulum, whilst the lower is d up and everted, only to a greater extent. Shortening may at fir slight, but is likely to increase at the end of a few days, as a res disimpaction of the fragments, or from the yielding of the refl fibres of the capsule, or from the tonic action of the muscles.

Union of the fragments is much more certain in this variety th the intracapsular, but it is often accompanied by a conside development of callus, which may subsequently impair the moven of the limb, whilst secondary bending and late increase of shortening may occur if the patient walks too soon.

The **Signs and Symptoms** of these two fractures may well be sidered together, the points of similarity and contrast being in way more effectually emphasized.

(*a*) The signs of *local trauma*, viz., pain, bruising, and swelling, be present in both ; but whilst slight in the intracapsular variety, are very marked in the extracapsular. It must not be overlo however, that even in the former the patient may fall on the affe hip after the fracture has occurred, and thus cause a conside amount of bruising.

(*b*) *Crepitus* is evident in the unimpacted forms of each ; but unnecessary and, indeed, extremely unwise to elicit it by for manipulation, especially in the intracapsular variety.

(*c*) *Loss of power* is perhaps more marked in the extracapsular than in the intracapsular. Cases of the latter in which the pa was able to walk into hospital some days after the accident ar unknown, and are probably due to impaction.

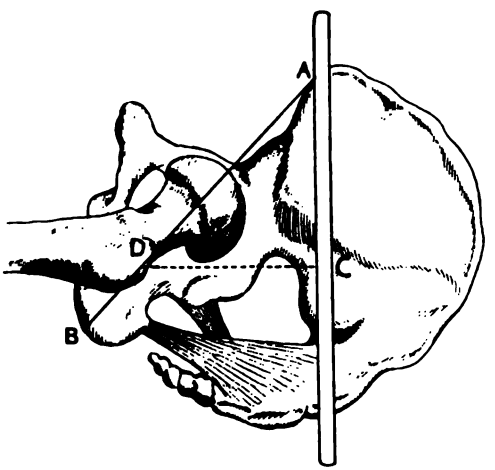
(*d*) *Eversion* is a most characteristic feature in both varieties limb lying absolutely helpless on its outer side. This displace is accredited to the natural weight of the limb, to the greater fra of the back of the cervix, causing it to be more comminuted tha anterior surface, and, lastly, to the greater power of the ex rotator muscles. *Inversion* has been met with in a few rare case is probably due to the violence in the particular instance directed from behind forwards, and to impaction of the fragme

(*e*) *Shortening* is slight in the early stage of intracapsular, and greater in the extracapsular, fractures. In the latter case the sh ing usually attains its maximum—viz., 1½ to 2½, or even 3 inch once ; but such is not always the case in the former. It is ind

acement of the trochanter upwards, due allowance being made osition of the limb as regards abduction or adduction.

he *position of the great trochanter* is of the greatest importance. sed above its ordinary level and everted; it is approximated iddle line of the body and to the anterior superior iliac spine, tes in the arc of a smaller circle than usual, the radius being kness of the trochanter alone, instead of including also the f the neck. The demonstration of this position is most im- and, amongst others, the following tests are employed:

n's line (Fig. 177) is one drawn from the anterior superior the most prominent point of the tuber ischii (AB). The f this (D) corresponds to the top of the great trochanter, if is placed in the axis of the body; but if either abduction or



7.—NÉLATON'S LINE AND BRYANT'S MEASUREMENT FOR ASCERTAINING POSITION OF GREAT TROCHANTER.

on is present, the top is situated slightly above or below the Definite elevation of the bone above the line indicates shorten- he limb due to dislocation backwards, fracture of the neck, or ion of the neck from disease.

t's Test Line (Fig. 177).—In this the patient lies flat on a tal couch, and a vertical line (AC) is drawn from the anterior r spine; a thin wooden rod held against the side answers this e admirably. The perpendicular distance of the top of the rochanter from the line (CD) is compared with a similar ement on the opposite side; definite shortening may thus be red. In the normal adult this measurement is usually about es.

s's bitrochanteric test indicates the amount of inward displace- It is conducted by measuring the distance between the outer

surfaces of the trochanters and the middle line of the body by m
of a rod graduated from the centre, along which two pointers v
outwards. Shortening in this direction will also be observed in i
dislocations of the hip-joint.

One other change in the great trochanter may be noted in the e
capsular form of fracture, which can be utilized as a useful diagn
feature between it and the intracapsular variety, viz., the g
amount of *thickening* of the process which is always produced, o
to the excessive development of callus. In the intracapsular va
it is rarely fissured or injured, and therefore no thickening occur

(*g*) Lastly, *relaxation of the fascia* between the crest of the ilium
the great trochanter (that is, of the upper part of the ilio-tibial b
is given as a characteristic feature of these fractures.

Diagnosis.—Simple *unimpacted* fractures are readily detected,
there can be but little difficulty in distinguishing the two forms, ei
from one another or from other injuries. The fact that an *impa*
fracture has occurred can also be easily made out as a rule, the p
eversion, and shortening sufficing to indicate its existence; but
very often difficult to say which of the two forms of fracture is pres
especially if the surgeon is not called till late in the case. The chara
of the accident and the age of the patient must be taken into acco
whilst the existence of fissuring or thickening of the trochanter, o
excessive amount of shortening, would suggest that the lesion
located near the trochanter. A *severe contusion* of the hip, wh
may be associated with marked eversion, is known from a fract
by the absence of shortening and crepitus; there is no displa
ment of the trochanter, which rotates in a normal manner. T
shortening which sometimes follows, owing to subsequent atro
of the neck, may, however, complicate matters. In a *dislocation* t
head of the bone can be felt in an abnormal position, and hence
difficulty should be experienced in its recognition. In *chronic os*
arthritis of the hip with antecedent shortening and marked bo
crepitus, there may be no history of accident, and no acute eversi
pain, or loss of power; possibly the existence of similar disease
other joints may assist the surgeon, whilst osteo-arthritis of the h
usually results in prominence of the trochanter, and not in flatten
as occurs after fracture. Moreover, the fascia above the trocha
is never relaxed in osteo-arthritis, always in fractures. It must
be forgotten that, after an intracapsular fracture, the patient m
fall, not on the injured side, but on the sound thigh, and cases ha
been known where the surgeon's attention was directed to the wr
limb owing to the amount of bruising there manifested. The X r
may be advisably employed to assist in making a diagnosis, but i
wise to pass them through a small diaphragm so as to get concen
tion of action, and a more defined shadow of the bones.

The **Treatment** of intracapsular fractures must depend in gr
measure, as already stated, upon the individual. If old, weakly, o
with a tendency to chronic bronchitis, long confinement to bed wo
have a most deleterious, if not fatal, effect. In such cases the li

is put at rest for a few days between sandbags, and cooling lotions applied. A Thomas's splint should be fitted as early as possible, and the patient encouraged to get about on crutches.

In a healthy individual with good physique, where bony union may be expected, the patient is kept at rest in bed for six or eight weeks, by means of Liston's *splint* (Fig. 178). This needs careful adjustment, but gives satisfactory results when properly applied. It should reach from the axilla to about 6 inches below the ankle, and is fixed to the leg and body either by bandages, or, better, by two broad sheets, which first firmly envelop the splint, and are then passed round the body, and finally secured by pins to the portion surrounding the splint. Before applying it, carefully-padded poroplastic foot-pieces are placed on either side of the ankle, so as to protect it from pressure, and a handkerchief or bandage passed round the foot and through the prongs at the end of the splint fixes it in position. A well-padded

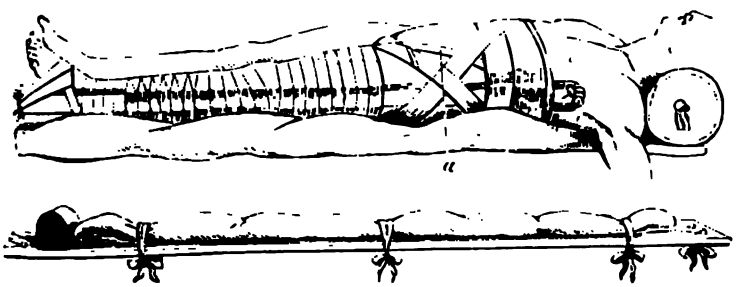


FIG. 178.—LISTON'S SPLINT PADDED AND APPLIED.
a, Perineal band.

perineal band is next applied, taking its purchase from the tuber ischii, and with its free ends passed through the two holes at the upper extremity of the splint; by tightening and tying these two together, the upper end of the splint is steadied. Extension of the limb is obtained by an elastic accumulator, or by weight and pulley. Lateral movement or rotation is prevented by slipping the lower end of the splint into a slot between two rectangular plates of metal screwed to a substantial wooden base, which rests on the bed. The handkerchief and perineal band will need occasional tightening to maintain the required position, and the latter must be renewed from time to time for purposes of cleanliness, and the parts well powdered with boric acid. At the end of six weeks or so the pelvis should be encased in poroplastic material or plaster of Paris and the patient allowed to get about on crutches, or a Thomas's splint is applied.

No attempt should be made to disimpact fractures in old people; rest and quiet are maintained by applying a long splint without extension, and bony union usually follows.

Extension by weight and pulley is required in so many different conditions that a description of its method of application is necessary.

Two pieces of broad adhesive plaster are prepared as in Fig. 17; they should reach from well above the knee to the malleoli. T upper ends are notched obliquely to make them fit better to the lim whilst the lower are folded on themselves so as to cover in the adhesi surface. A stirrup is then prepared as in Fig. 180; adhesive plas is fixed to a wooden spreader, rather broader than the ankle, with hole in its centre for the passage of a cord. The long strips a applied on either side of the limb, and secured to it by a woollen boracic bandage, which should not extend much below the kn The stirrup is then attached to the strips by safety-pins (A_1 to A the cord is passed over a pulley fixed to the end of the bed, and to is attached a suitable weight. The lower end of the bed is raised

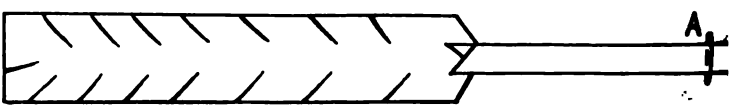


FIG. 179.—METHOD OF CUTTING AND FOLDING THE STRAPPING IN APPLYING EXTENSION.

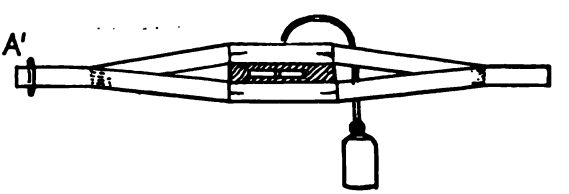


FIG. 180.—METHOD OF ARRANGING STRAPPING ON STIRRUP OR 'SPREADER.' The end A_1 is attached by a safety-pin to A, the end of the upper piece of strapp in Fig. 179, and a similar attachment is made on the other side of the limb the other piece of strapping.

placing the legs on blocks, so that the weight of the body may act a counter-extending force. Various splints may be combined w this appliance without impairing its value.

In America *Buck's* method of *extension* is much employed and gi great satisfaction. It may well be utilized in fractures of the cer The above-described extension is employed, but in addition a th strip of plaster, 1 yard long and 2 inches wide, is fixed to the back the calf, brought down below the sole of the foot, and secured b roller bandage. A Volkmann's sliding rest (Fig. 181) is then pla under the limb, and secured to it by the loose end of strapping an bandage.

Treatment of Fracture near the Trochanter.—The long splint w extension, or Buck's extension alone, will sometimes suffice for this c dition, good bony union usually occurring, though with some shorten In other cases it may be advisable to make extension from the kn and to keep the limb slightly flexed, as on a double inclined pl

Probably this type of treatment is best carried out by the use of *Hodgen's splint* (Fig. 182). For our description of it we are chiefly indebted to Mr. Golding Bird. It consists of a rigid iron frame in the form of the letter U, the outer limb reaching from the anterior superior spine to 3 inches below the instep, and the inner from the adductor longus tendon to the same spot, where the two limbs unite in a cross-bar 3 inches in width. The sides taper with the limb, and should be $\frac{3}{4}$ inch further apart than the diameter of the limb at any point. At the upper end the bars are united by an arch of the same material, which should correspond to Poupart's ligament; one or two similar arches are placed at equal points lower down. The splint is slightly bent at the knee.

Before applying the splint, an ordinary extension apparatus is attached to the limb. Strips of house-flannel, about 7 inches wide,

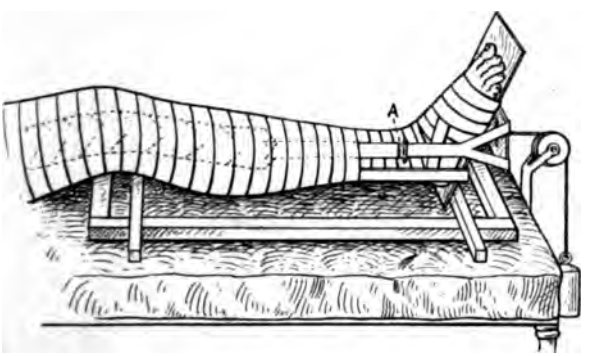


FIG. 181.—VOLKMANN'S SLIDING REST FOR FRACTURES OF THE FEMUR.
A points to the junction of the upper and lower pieces of strapping, as in Figs. 179 and 180.

are then cut and arranged beneath the limb at right angles to its direction, each one overlapping the next; the length of the strips should be rather more than the circumference of the limb at the spot to which each is to be applied. The splint is then placed in position; the strips of flannel are raised in succession, and, being lapped over the bar, are pinned or stitched there, so that the limb lies in a flannel trough, from which only the upper surface projects. The cord of the extension appliance is then securely tied to the lower end of the splint. Two hooks are soldered to each side of the frame, and to them are attached cords, which are brought together over the limb; another stout cord is tied to these and passes over a pulley attached to a vertical post at the end of the bed; it is weighted to a sufficient extent. The limb when the weight is applied should lie free of the bed, even to its extreme upper limit. It is advisable to encircle the thigh in Gooch splinting, a narrow piece in front between the bars and a broader piece behind. These are well padded and secured by bandages which extend over the whole length of the

apparatus; finally, starch is rubbed in so as to fix it more firm
When correctly applied, the splint itself is pulled on by the extend
force (the weight), and this is transmitted to the limb through t
stirrup end, which should be taut 'like a harp-string'; laxity of t
end indicates slipping of the splint, and necessitates its readjustme

When impaction of an extracapsular fracture has occurred in you
and active individuals, it is quite justifiable to give an anæsthetic, a
forcibly break it down, so as to prevent subsequent shortening.

2. **Fracture of the Great Trochanter** is very rare, and always due
direct violence; in the young it occurs as an epiphyseal lesion. Th
trochanter, or a portion of it, is entirely separated from the rest of th
bone without any loss of the continuity of the shaft. Independe
movement of the fragment with crepitus is usually obtainable; an

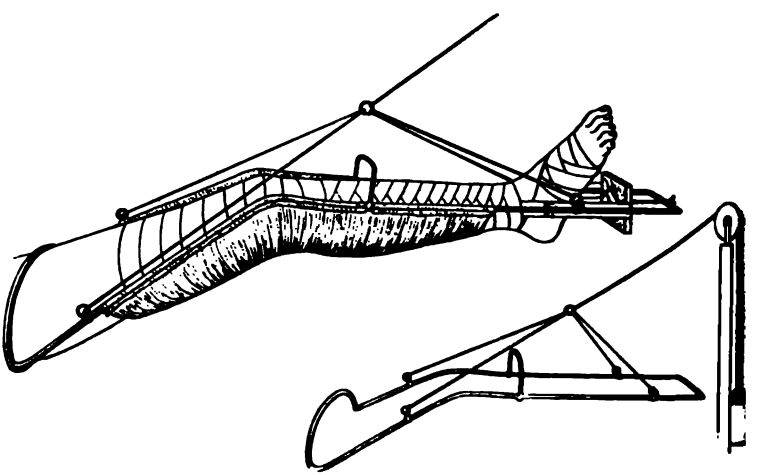


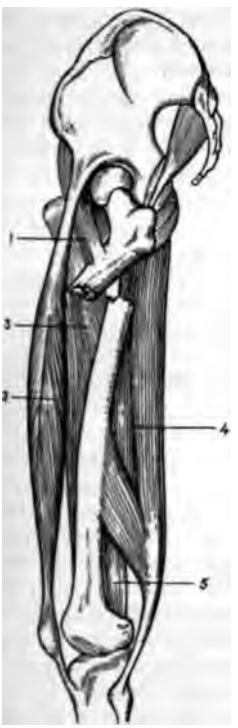
FIG. 182.—HODGEN'S SPLINT AND ITS METHOD OF APPLICATION.

if the displacement is at all marked, an operation to fix it by mea
of a plated screw or ivory peg should be undertaken.

3. **Fracture through the Great Trochanter** (the *per-trochanteric* fract
of Kocher) closely resembles the extracapsular fracture, the lin
running from the inner and under part of the neck obliquely upwa
and forwards through the base of the trochanter. The lower fragme
including the lesser trochanter, is drawn upwards and backwa
towards the sciatic notch, and forms a projecting mass behind, so
what simulating a dislocation; the tip of the trochanter can, howev
be felt separately, not moving with the shaft. Such cases may
treated by extension with the long splint, or perhaps better
Hodgen's apparatus.

4. **Separation of the Upper Epiphysis of the Femur.**—The up
cartilaginous end of the femur in infants includes not only the he

t also both trochanters, and there is no case on record of com-te detachment of this portion. Ossific centres early appear for ch of these three projections, and by the rapid growth upwards of shaft they are separated from each other by the fourth year, the ck thus being really constituted as an outgrowth of the shaft. The iphysis of the head has been completely detached in a considerable mber of cases, but the accident is not so common as in the humerus,



. 183.—FRACTURE OF UPPER THIRD OF FEMUR, SHOWING DISPLACEMENT OF BONE. (AFTER GRAY'S 'ANATOMY.')

lio-psoas tendon ; 2, rectus ; 3, adduc-rs; 4, biceps ; 5, inner hamstring ndons.

FIG. 184.—FRACTURE OF LOWER THIRD OF FEMUR, SHOWING DISPLACEMENT OF LOWER FRAGMENT BACKWARDS. (AFTER GRAY'S 'ANATOMY.')

1, Rectus ; 2, biceps ; 3, semi-membranosus and semi-tendinosus ; 4, gastrocnemius.

ing to the protection given by the depth of the acetabulum. The nomena closely simulate those of an intracapsular fracture, but less obvious (p. 537). Impairment of growth may follow, and sibly the shape of the head and neck may be so altered subse-ntly as to simulate the condition known as coxa vara. Treatment e lesion is by prolonged fixation of the limb in an abducted position.

ractures of the Shaft of the Femur are extremely common

accidents, in spite of the apparent strength of the bone. Any p may be involved, particularly the centre, whilst they occur at t lower end more frequently than at the upper. In the latter situatio they are usually due to indirect violence, whilst at the lower end the generally result from direct injury; either form of violence may lea to a fracture about the middle of the bone.

In almost every case *displacement* occurs, the direction and amount of which depends not only on the line of fracture, but also on the situation. In the *upper third* (Fig. 183), the small upper fragment is usually tilted forwards by the ilio-psoas, and abducted and everted by the gluteus minimus and external rotators; whilst the lower fragment is drawn upwards and to the inner side of the upper by the hamstrings and adductor muscles, marked eversion also resulting, partly from the weight of the foot, and partly from the action of the adductors; but such a complicated displacement is not always present.

In the *middle third*, if due to indirect violence, the line of fracture usually slants from above downwards and backwards, causing a simple overriding of the fragments or an angular deformity. The lower fragment is drawn upwards and inwards, either in front of or behind the upper fragment, and is usually everted. The upper fragment is sometimes tilted forwards. If due to direct violence, the fracture is more or less transverse, often comminuted, and any form of displacement may then occur.

In the *lower third* the fractures often arise from direct force, and are transverse; the lower fragment may then be tilted backwards by the gastrocnemii muscles, and compress or rupture the popliteal vessels, perhaps causing gangrene (Fig. 184). Oblique fractures from indirect violence, sloping from above downwards and forwards, are also met with; the upper fragment is driven into the substance of the quadriceps muscle and may become fixed in it, projecting immediately beneath the skin, whilst the lower fragment is drawn up behind. If such a case is left unreduced, non-union is likely to ensue; the knee-joint is generally penetrated by the lower end of the upper fragment.

Treatment.—In the *upper third*, where the upper fragment is often too short to be controlled by any splint, reduction of the deformity is accomplished by flexing the thigh, and making extension from the knee, the lower fragment being thus brought into the same axis as the upper. Manipulation will usually correct any lateral displacement. The limb must be confined in this position by some form of inclined plane, such as a Macintyre's splint, with a long thigh-piece and with small straight wooden splints or a piece of Gooch's splinting fixed, if necessary, to the front and outer sides of the limb, over the seat of fracture. The splint is slung at the knee, the foot-piece being fixed to blocks of wood, a little lower than the level of the knee. If these precautions are not taken, an ununited fracture, with the upper fragment in front of the lower, is likely to occur. Hodgen's apparatus also answers admirably in these cases.

In the ***middle third*** of the thigh, where the upper fragment can be controlled by splints, shortening is prevented by extension (p. 542), the thigh being surrounded by pieces of Gooch's splinting, which grasp the muscles and keep the parts at rest. The limb is then placed between sandbags, or secured on a Liston's splint. A half-box splint (*i.e.*, a long splint with a back-piece) may be successfully employed in many of these cases, the limb being firmly bandaged to the appliance. Where the fracture is oblique, with a good deal of tendency to overlap, Hodgen's apparatus may be utilized.

In the ***lower third***, if there is any tendency to displacement of the lower fragment backwards, a Macintyre's splint, with a long thigh-piece and the knee well flexed, may sometimes be employed, together with a short anterior thigh-piece of Gooch's splinting; but in the oblique type, if the upper fragment has penetrated the quadriceps, operation alone holds out any prospect of bringing the parts into apposition, the muscular fibres being divided sufficiently to allow the projecting end of the bone to be replaced, and if necessary wired or pegged. In other cases the ordinary long splint or Hodgen's will be required.

In children, Bryant's plan of treatment is excellent; it consists in slinging the limb from a crossbar at right angles to the body, with or without a back-splint, reaching from the heel to the nates, and short lateral splints, thus obtaining extension by utilizing the weight of the body, whilst the bandages, etc., are kept from being soiled. If a long splint is used for children, a double one (*e.g.*, Hamilton's splint) with a crossbar below is the best. Plaster of Paris or starch bandages may be early applied in adults, but only in the later stages in young children, as they are difficult to keep clean.

Fractures of the Lower End of the Femur.

1. **Transverse Supracondyloid Fracture** is practically identical with that involving the lower third of the femur; the lower fragment is rotated backwards by the action of the gastrocnemii, thus endangering the integrity of the popliteal vessels, and predisposing to non-union, if the deformity is overlooked.

2. **T- or Y-shaped Fracture of the Condyles.**—In this a transverse fracture is complicated by a fissure, which runs into the joint, separating the two condyles. The symptoms are much the same as the above, but the joint is distended with blood, the bone may feel broader than usual, and crepitus may be detected. The **Treatment** is the same as for transverse fracture.

3. **Separation of either Condyle** always results from direct violence, the line of fracture being oblique. There is no shortening, but the leg may be deflected towards the side injured, and the joint is distended with blood. It may move separately from the shaft, and give rise to crepitus. **Treatment.**—Reposition is easily effected when the limb is slightly flexed, and it is best put up in this position.

Occasionally a small portion of the condyle may be detached and

lie loose in the knee-joint; when the immediate symptoms due to t injury have subsided, the signs of a foreign body in the joint m become evident.

4. **Separation of the Lower Epiphysis of the Femur** is not a very ra accident, and closely simulates a transverse fracture. The epiphy is generally displaced forwards by the traction of the quadriceps the tibia, and the vessels are then compressed by the lower end the diaphysis, and this may lead to gangrene. Suppuration occu in a fair proportion of the cases. **Treatment.**—Reduction is effect by an assistant making traction on the tibia in the line of the lim so as to stretch the quadriceps; then the thigh is gradually flexed l the surgeon, standing above and with both hands clasped beneath The epiphysis is by this means restored to its normal position, a the limb is kept flexed by a bandage at about an angle of 60°, a laid on its outer side with an icebag applied. Passive movement carefully commenced in a fortnight.

5. **Longitudinal and Spiral Fissures** are met with in the femu running down to the knee-joint, but causing no characteristic sym toms beyond pain and hæmarthrosis. Early passive movement necessary to prevent impairment of function.

Fractures of the Patella.

The patella is broken either by muscular force or by direct violen and the conditions produced are so different that a separate descr tion is necessary.

1. **Fractures by direct violence** may traverse the bone in a direction, but are most often vertical or star-shaped, and frequen comminuted. They are usually mere fissures without displaceme owing to the aponeurosis or capsule of the bone remaining inta There is a good deal of subcutaneous bruising, and perhaps soa effusion into the joint, whilst on careful palpation the fissure m be felt, and crepitus occasionally detected. **Treatment** consists keeping the limb at rest on a back-splint, and perhaps applyi evaporating lotions. Passive movements must be commenced ea where there has been much hæmorrhage into the joint. Operati measures are rarely required.

2. **Fractures due to muscular force** are always transverse, usua complete, and since they involve the fibrous aponeurosis, consid able displacement occurs.

Mechanism.—When the knee is semi-flexed, the patella is pos upon the front of the condyles of the femur, resting upon the mid of its articular surface; in this position any sudden and violent co traction of the quadriceps, as in attempting to recover one's equi brium after having slipped, takes the bone at a disadvantage, and m succeed in snapping it. Possibly in some people there is a pred posing weakness, as cases are not rare in which the other bone yie subsequently, although perfect functional repair has been obtai in that first broken. The fragments may be almost equal in

(Fig. 185), but the lower is often the smaller; either of them may be again divided vertically, or comminuted.

The **Signs** of this fracture consist of loss of power in the limb, pain, distension of the joint with blood, and separation of the fragments, which can be readily felt and sometimes seen (Figs. 185 and 186). This displacement is due to unopposed muscular action, and is increased when the lesion involves the lateral expansions of the vasti muscles, as is not uncommon. Union by bone is rarely obtained apart from operation, a fact explained partly by the separation of the fragments, and partly by the carrying in of loose tags of the fibrous aponeurosis or capsule, which yields at a different level to the bone. Fibrous union is the usual result, and when this is short and strong, it may be quite satisfactory; but more commonly

FIG. 185.—FRACTURE OF PATELLA, WITH SEPARATION OF FRAGMENTS. (AFTER GRAY'S 'ANATOMY.')

1, Rectus; 2, vastus externus; 3, ligamentum patellæ.

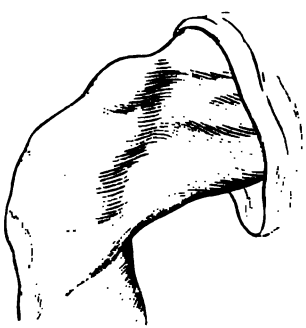


FIG. 186. APPEARANCE OF KNEE AFTER FRACTURE OF PATELLA.

the bond of union yields when the limb is used, so that the two fragments are once again separated, merely a bridge of fibrous tissue intervening, the joint being often very weak, and the power of active extension of the leg lost.

The **Treatment** of these cases may be grouped under three headings, viz., by retentive apparatus, by subcutaneous operation, or by the open method.

1. *Simple retentive apparatus* may be employed in cases where the fragments are not widely separated, and can be readily brought into contact and maintained in apposition.

Some surgeons depend mainly upon plaster of Paris to effect this. If there is but little effusion, the limb is extended, swathed in cotton-wool and a flannel bandage, and over this the plaster casing is applied. As the apparatus becomes loose from muscular atrophy,

it will need readjustment. The patient is kept in bed for thre four weeks, but the plaster is retained for as many months, after that a suitable knee support (Fig. 187) is kept on for n twelve months. Where there is much effusion after the acci the limb is placed on a back-splint and kept cool by ice or evapor lotion, until the fluid has been absorbed; or the joint ma aspirated in order to hasten matters. The plaster is then app and the same routine followed. The chief objection to this pl the enclosure of the limb in the plaster case, so that the muscles joint cannot easily be got at for purposes of massage.

Another plan consists in applying a large piece of moleskin pl over the front and sides of the extensor surface of the thigh, reac half-way up to the groin, and terminating below in two la elongated ends or tags, to which elastic traction is applied. limb is placed on a back-splint, with a foot-piece, beneath which elastic accumulator is firmly tied. Removal of the effusion in joint may be hastened by the use of the aspirator. At the en about six weeks the patient is allowed to get about in a plaste Paris casing, and then, about three months after the acciden special knee-splint is substituted (Fig. 187), which allows of on small amount of mobility at first, but, by filing away a stop, this be gradually increased, until a full range of movement is permit It is probable that only fibrous union is obtained by this metho treatment.

2. To insure more accurate apposition and a firmer union, and to avoid the risks necessarily associated with laying the joint o various *subcutaneous operations* have been adopted. Of these the m satisfactory is that recommended by Mr. A. E. Barker, who ties fragments together by silver wire (Fig. 188). An opening is m with a tenotomy knife into the joint just below the lower segm through which any effused blood or synovia can be squeezed, along which a curved hernia needle is passed, traversing the artic tion from below upwards, and emerging through the skin above upper fragment. A piece of sterilized silver wire is then ca back under the bone. The needle is again inserted at the same below, and carried in front of the bone under the skin, emergin the same point above. The upper end of the wire is thre through it, and by this means brought out at the lower ope The bone is thus encircled, and by tightening and twisting the the fragments are brought into apposition. The ends are cut off pushed back under the skin. The punctures are treated antiseptic and the limb placed on a back-splint for a week or so, when pa movement is commenced, the patient being allowed to walk abo the end of the second week, and discarding all apparatus at the e five weeks. Necessarily, a certain element of risk is admitted in subcutaneous operation, and, in our opinion, if it be justifiabl incur such, it is best to proceed by—

3. The *open plan of treatment*, advocated and perfected by Lord Li which consists in freely exposing the interior of the articulation, d

ing the joint of all blood-clot, removing tags of fascia or aponeurosis which may curl in over one of the broken surfaces, and wiring the fragments securely together.

No surgeon should attempt this operation unless well assisted and thoroughly *au fait* with the details of antiseptic work. At King's College Hospital this practice is now almost exclusively followed, and the results have been most satisfactory, no instance of serious mischief

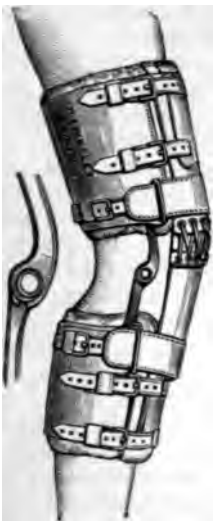


FIG. 187.—FRACTURED PATELLA.*

This splint is intended for use after fibrous union of the upper and lower fragments. The steel joints at the sides are so made that the degree of flexion can be gradually increased. In case of a slip the knee cannot bend more than is allowed by this *adjustable stop*, and thus overstretching or rupture of the newly-formed bond of union is prevented. To assist extension of the limb, a strong elastic band joins the upper and lower part of the splint anteriorly; this also is adjustable, and greatly assists the weakened quadriceps in walking.

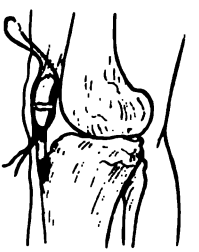


FIG. 188. BARKER'S METHOD OF SUBCUTANEOUS SUTURE AFTER FRACTURE OF PATELLA.

FIG. 189.—POSITION OF SILVER WIRE IN OPEN OPERATION FOR FRACTURED PATELLA.

from the operation having arisen for many years. A horseshoe-shaped flap is usually dissected up, exposing the bone. All blood-clot is removed, and the fractured surfaces cleared of all clot and fibrous shreds, which are very often adherent. Tracks for the wire sutures are now made by a bradawl, extending from the upper or lower end

* For the loan of this block we are indebted to Mr. T. Hawksley, 357, Oxford Street, W.

through the centre of the bone, so as to emerge on the fractured surface just in front of the articular cartilage (Fig. 189); should the awl emerge at different levels on the faces of the fragments, cartilage or bone must be chipped away to make a channel in which the wire may lie, so that the two fragments are exactly level, with no inequality of the articular cartilage. A sterilized silver wire of suitable thickness is then passed; the bones are brought into apposition, and the wire twisted into a knot or loop, which is hammered or pressed down into the tendinous or periosteal tissue over the upper fragment, so as to keep it from projecting under the skin and causing irritation. A second wire is sometimes needed in order to prevent rotation of the fragments. The wound is closed, and the limb kept on a Gooch's splint. In healthy adults passive movement may commence in ten days, and by the end of a fortnight the patient is allowed to walk in the simpler cases; but in complicated fractures and in elderly people it is wiser to keep the limb immobilized for a longer period.

It is perhaps advisable not to undertake this operation immediately after the accident. The limb should be kept at rest on a back-splint and an icebag applied for a week or ten days, so as to allow the joint to recover from the effects of the injury it has sustained; there is then much less risk of septic complications.

The chief advantage of operative treatment is not so much that it alone can ensure bony union, but that the time expended is so much shortened. When a patient can afford to spend twelve months in remedying the accident, and can pay for suitable massage and an expensive splint, firm fibrous union can usually be obtained, and this may be just as satisfactory as if bony union had occurred.

In *old cases*, where the fibrous union has stretched and the utility of the limb is seriously impaired, the open operation holds out the only hope of helping the patient, although it is always a matter of considerable difficulty. The fibrous tissue must be dissected away, and the surfaces of the fragments freshened, if need be, with the saw. To obtain apposition, the upper fragment must be freely detached from the femur, to which it is very often adherent, and the rectus muscle, which is secondarily contracted, may need to be partially divided. The limb should be well raised to relax the quadriceps and thus diminish tension on the bond of union, and lowered inch by inch on succeeding days. The muscle is thus stretched to accommodate itself to the altered conditions.

If the fragments cannot be absolutely brought together, the same treatment may be adopted, and the patient allowed to get about with silver wires between the fragments; the quadriceps is stretched by this means, and a subsequent operation may prove successful in gaining bony union.

Fractures of the Leg.

Fractures of the Tibia alone.—Several varieties are described: (*a*) The *upper end* is usually broken as a result of direct violence, the fracture being often comminuted. The characteristic features are

not always very evident at first, since considerable swelling and ecchymosis are produced. Occasionally as a result of falls on the heel a T-shaped fracture occurs, the tuberosities being broken off and the upper end of the shaft impacted into one or both of them. A few cases of vertical separation of one of the tuberosities alone are also on record. **Treatment** consists in placing the limb upon a back-splint, as Macintyre's, with the knee bent, and, as a rule, satisfactory union ensues, though possibly with some distortion. (*b*) Fracture of *the shaft* of the tibia, apart from the fibula, is usually caused by direct violence. It is transverse in the upper part of the bone, and oblique below (Plate VI.). The fracture is diagnosed by feeling an irregularity on running the fingers along the shin, together with pain at the spot on firmly grasping the bones above and below. There is often but little displacement, since the fibula acts as a splint, but the lower end of the upper fragment, which is usually pointed, is pushed forwards by the action of the quadriceps and may pierce the skin. The **Treatment** consists in the application of back or side splints (Cline's) for a few days until the swelling has gone down, and then the limb may be put up in plaster. If the bone has been comminuted, treatment will be more protracted. (*c*) The *internal malleolus* is occasionally separated as the result of direct injury, apart from any other osseous lesions, constituting what is known as 'Wagstaffe's fracture.' There is comparatively little displacement, but the malleolus is loose, and crepitus can usually be obtained on moving it backwards and forwards. Union by fibrous or osseous tissue ensues, but usually in a more or less abnormal position, in consequence of which the integrity of the ankle-joint is disturbed, and weakness or lameness may follow. **Treatment** consists in the application of lateral splints. If there is any difficulty in keeping the parts in apposition, an incision should be made, and the malleolus wired or pegged to the tibia.

Fractures of the Fibula alone are by no means uncommon, usually occurring as a result of direct violence. There is no displacement or deformity, but the patient complains of pain localized to some particular spot, and this can usually be elicited by grasping the bones above and below, and compressing them laterally ('springing' the fibula). Sometimes the diagnosis is extremely uncertain, and then the X rays prove useful. **Treatment** consists in immobilizing the limb in a plaster case.

Fracture of both Tibia and Fibula is a very common accident, due to both direct and indirect violence; if to direct violence any part may be injured, both bones yielding at the same level; but if in consequence of an indirect injury, the tibia usually gives way at its weakest part, viz., at the junction of its middle and lower thirds, and the fibula at a slightly higher level. The fractures are often oblique, running in any direction according to the character of the violence, though the obliquity is most frequently directed downwards, forwards, and inwards. The lower fragment is generally drawn upwards on account of the contraction of the powerful calf muscles, and often

rotated outwards from the weight of the foot; hence there marked shortening, which can usually be overcome by The ordinary characteristics of a fracture are very evident, little difficulty can ever be experienced in making a diagnos fracture is likely to become compound when due to indirect owing to the sharp end of the oblique fragment of the tibia the upper, piercing the skin. Skiagraphy is exceedingly u enabling one to decide as to the character of the lesion, and grams should be taken both from the front and from the sid appearances are often very different (compare Plates XXI. and

The fracture of the tibia has been proved by skiagraph frequently of the *bec-de flute* type, and is then probably alway much to forcible torsion of the limb as to vertical strain. T tion is a very important element in these cases, and the lowe the upper fragment rides prominently forwards (the 'ridi ment'). The shortening is sometimes less marked than in oblique fractures, but there is much greater difficulty in satisfactory approximation of the fragments, even after fre ends of the tibia by operation. This difficulty is probably cases due to the broken ends of the fibula becoming engag fibro-muscular tissues around it, and will necessitate an incis this bone in order to free them.

Treatment.—In the simpler cases reduction is accompli flexing and fixing the knee, so as to relax the muscles of and then making traction on the foot and manipulating t into position. The tendo Achillis may, if necessary, be divi will usually suffice to put up the limb in a pair of side-splin as Cline's, the longer one with the foot-piece being intende outer side. In other cases it may be better to apply a broad splint with a rectangular foot-piece, *e.g.*, Macintyre's, and tw splints; or the old-fashioned half-box splint may be em Some surgeons recommend an anterior wire splint, extendi above the knee to the foot, the leg being subsequently slun flexed position. This may be advantageously modified by co it with an additional casing of plaster of Paris. Whatever tr is adopted, it is necessary to see that the length of the limb as possible maintained, and that no rotation of the lower fra present. To ensure absence of rotation, all that is needed i that the inner aspect of the great toe, the subcutaneous s the internal malleolus, and the inner border of the patella, s same line, and correspond with the opposite limb. Union sufficiently advanced in two or three weeks at the latest to the limb being put up in plaster, which must be retained for another month, and even then a good deal of lameness is persist, which will need subsequent massage. In oblique s fractures there is often very great difficulty in getting the fr together, and even more in maintaining them in good Taking into consideration the degree of permanent deprecia a man (especially if of the labouring classes) suffers from

PLATE XXI.

Fracture of both Bones of the Leg, seen from in Front.

PLATE XXII.

SAME FRACTURE AS IN PLATE XXI, SEEN FROM THE INNER SIDE

study of the two skiagrams it will be noticed that both lower fragments are displaced outwards, with but little alteration in their antero-posterior axes.

union of these bones, we have no doubt that the suggestion to cut down on, and wire, screw, or peg the fragments together, is fully justifiable in the hands of skilled surgeons. In the spiral cases the operation may also have to include an incision to free and fix the fibula.

Fractures in the neighbourhood of the Ankle-joint are usually produced by indirect violence, the foot slipping, and leading primarily to a displacement of the ankle, the fracture being a secondary result. They would therefore be better described as **Fracture-dislocations at the Ankle-joint.**

1. *Displacement of the Foot outwards* is by far the most common variety, resulting usually from the patient slipping on the inside of the foot, as from off a kerbstone. Several distinct varieties of lesion are now recognised.

(*a*) In *Pott's Fracture* (Plate XXIII.) sudden abduction of the foot results in severe strain upon the internal lateral ligament, which gives way, or the base of the internal malleolus is torn off. The astragalus is thereby driven against the inner aspect of the external malleolus, and tends to displace that portion of bone outwards. The force is thence transferred up the fibula, which bends and breaks at its weakest spot—that is, about three inches above the tip of the malleolus—the upper end of the lower fragment being displaced inwards towards the tibia. The inferior interosseous tibio-fibular ligament remains intact, and hence the foot itself is merely rotated outwards or abducted, and the heel is drawn upwards, whilst the toes point downwards. If the ligament alone is torn, the malleolus projects beneath the skin, and may, indeed, protrude through it; there is always much bruising and ecchymosis on the inner side of the ankle. If the malleolus itself is torn off, a distinct sulcus can usually be felt between it and the lower end of the tibial shaft. In both these types the ankle-joint is necessarily laid open, and there is probably much hæmorrhage into neighbouring tendon sheaths.

(*b*) In *Dupuytren's Fracture* a much more serious lesion is produced. The interosseous tibio-fibular ligament yields more or less completely, or the flake of bone to which it is attached is torn off; the foot, carrying with it the lower portion of the fibula and the superficial flake of the tibia, which has been detached, is displaced firstly outwards, and so long as the upper surface does not clear the lower articular surface of the tibia, there is merely lateral displacement with marked abduction of the foot and increased breadth of the ankle (Plate XXIV.). Should the force continue to act, the astragalus may be carried sufficiently outwards to clear the lower end of the tibia, and then an upward and to a less degree a backward displacement is added, causing great eversion of the foot and deformity of the ankle. On the inner side either the ligament or the malleolus may yield.

(*c*) In another variety the injury consists in the usual type of fracture of the fibula, associated with an almost transverse fracture of the tibia, just above the base of the inner malleolus (Plate XXV.). In this form, the lower end of the shaft of the tibia projects beneath

the skin, and is likely to be mistaken for the tip of the malleolus; if this error is committed, and the fracture allowed to unite without proper rectification, considerable deformity results. In rare instances, the lower end of the tibia may project through the skin, thus rendering the fracture compound.

(*d*) A similar injury in children may produce a separation of the lower epiphysis of the tibia, whilst the fibula yields in the usual situation. The line of separation in the tibia is more or less transverse, but may extend into the diaphysis on the outer side.

In almost all of these varieties the ankle-joint itself is opened, and this, combined with the amount of bleeding that occurs into tendon sheaths and muscles around, and the difficulties often associated with fixation of the fragments, explains why the results of these cases are frequently so unsatisfactory. Should union occur with the foot in a false (*i.e.*, everted) position, a large mass of callus develops between the shaft of the tibia and the malleolus.

2. *Displacement of the Foot Inwards.*—When the patient slips on the outer aspect of the foot, the astragalus is forcibly driven against the

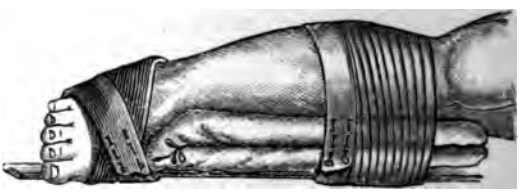


FIG. 190.—DUPUYTREN'S SPLINT APPLIED FOR POTT'S FRACTURE. (TILLMANNS.)

inner malleolus, which may be broken off or impacted into it. The outer malleolus is dragged inwards with the foot, and owing to the integrity of the inferior tibio-fibular ligament, which acts as a fulcrum, the fibula yields at the same spot as in Pott's fracture. The foot is displaced inwards, and perhaps slightly backwards.

3. *Displacement of the Foot backwards*, by catching the heel and tripping forwards, is usually associated with fractures of the tibia and fibula in the same position as in Pott's fracture, but eversion of the foot is absent (see dislocation of the ankle backwards, p. 643).

Treatment.—In reducing these fractures, traction should be made upon the foot after the tension of the calf muscles has been relieved by flexing the knee, or by tenotomy of the tendo Achillis; the position of the internal malleolus must be accurately defined. Before applying the splints, careful attention must be given to the following points: (*a*) The foot must be maintained at right angles to the leg; (*b*) the heel must not project unduly backwards; and (*c*) the foot must not be rotated on the leg—*i.e.*, the inner surfaces of the great toe, internal malleolus, and patella must be in the same line. A pair of Cline's splints is often sufficient to steady the parts in simple cases. Some patients are better treated, however, by a Dupuytren's splint (Fig. 190), which is really a Liston's splint on a small scale. It reaches from the

PLATE XXIII.

Pott's Fracture, showing Separation of Internal Malleolus and Fracture of Fibula.

(For the loan of the negative from which this plate was prepared, we are indebted to Mr. Caldwell, of 62, Welbeck, Street.)

PLATE XXIV.

FRACTURE, WITH WELL-MARKED DISPLACEMENT OUTWARDS OF
OT, AS WELL AS OF THE LOWER FRAGMENT OF THE FIBULA AND
ERNAL MALLEOLUS. (SKIAGRAM TAKEN FROM IN FRONT.)

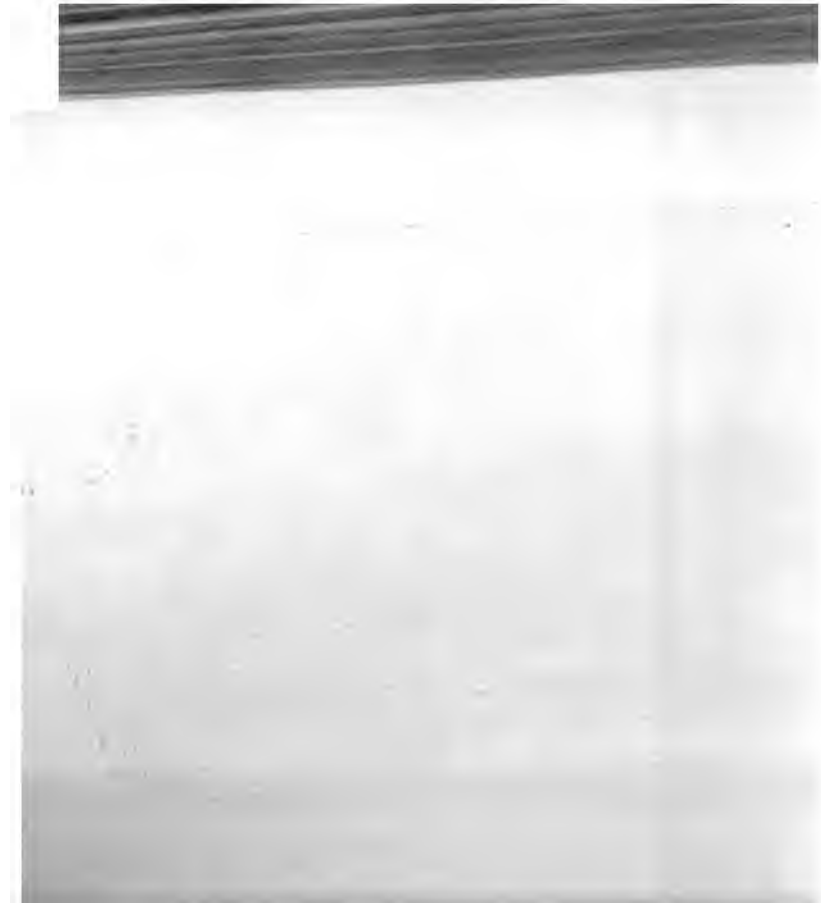
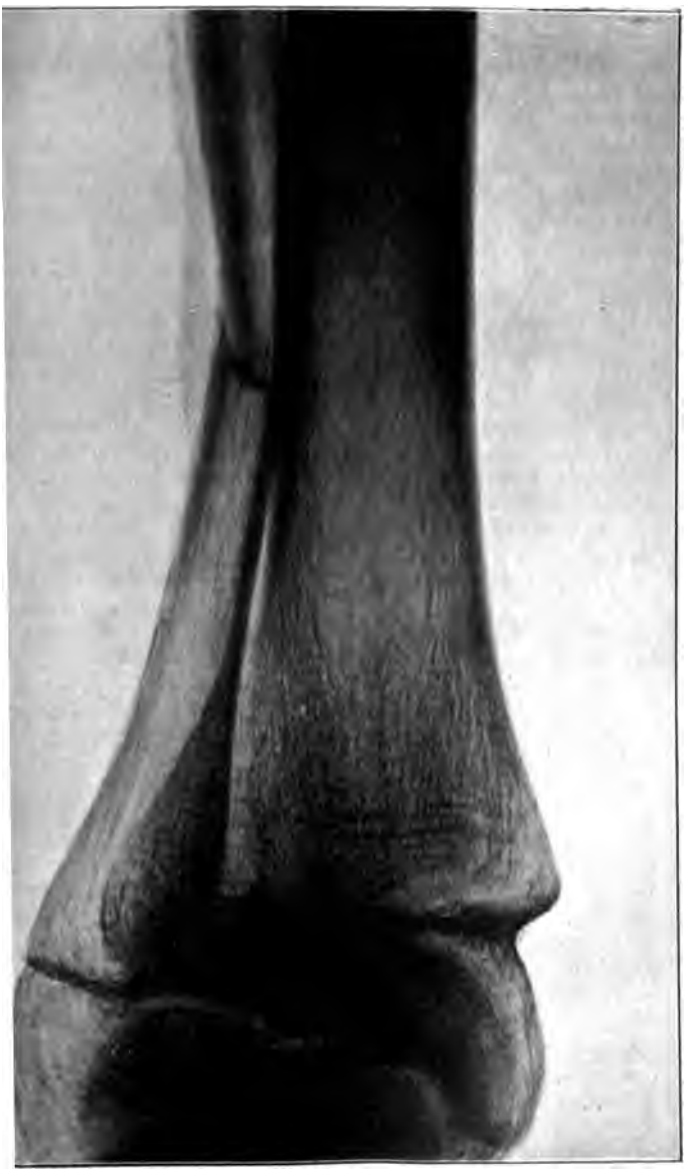


PLATE XXV.



S OF LOWER EPIPHYSIS OF TIBIA ASSOCIATED WITH FRACTURE OF
AT THE USUAL SITE OF A POTT'S FRACTURE, WHICH IS THEREBY
LY SIMULATED. (Mr. A. D. Reid.)

ed in combination with a Dupuytren. It consists of a flat wood, well padded, extending from the knee to the ankle crest of the tibia; the lower end is shaped like a horseshoe, mbs passing one on either side of the foot. A handkerchief f bandage is applied, with its centre over the point of the asses up on either side between the splint and the foot, r the former structure, and is tied behind the heel, which ted forwards. As soon as possible, the limb should be put er-glass or plaster of Paris.

simpler forms, early massage may be employed, and then etentive apparatus necessary is some adhesive plaster o as to cover in and encase the foot and ankle. In the cult cases, where there is considerable displacement and iculty in keeping the fragments together, operation to fix uite justifiable.

es of vicious union after Pott's fracture, it is usually to re divide the fibula, and to excise a V-shaped portion of the tibia extending into the ankle-joint, so as to enable olus to be brought in contact with the shaft.

e of the Os Calcis may result from direct violence, such as fall on the heel, or possibly from muscular action, the being then separated, or the shell of bone into which the hillis is inserted being torn off. The fragment thus is displaced upwards by the contraction of the calf nd the resulting deformity is very evident. If the line of asses through the body of the bone there may be no dis-t, owing to the attachment of the interosseous and lateral ; but should the sustentaculum tali or greater process be ie arch of the foot may be more or less flattened. When all from a height, the bone is often comminuted and the foot ised and swollen. **Treatment** consists in immobilizing the plaster case if there is no displacement; but where the

a height, or from direct violence applied to the foot, as by s falling upon it. The lesion is often a severe comminuted c portions of the bone may be displaced forwards or bac making a marked projection beneath the skin. In a case u under our care at hospital, the patient had fallen down a lift, a on his feet; both astragali were smashed, and this probabl his life. Such accidents are often associated with lesions of t or fibula, and possibly even of the femur. The whole regio ankle becomes infiltrated with blood, and an exact diagnosis i times difficult. **Treatment** consists either in immobilizatio is likely to be followed by stiffness of the ankle, or in bad c excision of the bone or of projecting fragments.

Occasionally in less severe accidents the bone merely splits the lesion being usually situated about the neck. Such is du to the weight of the body flattening out the arch of the bone the limits of elasticity, or, if the foot is dorsi-flexed, to penetr the bone by the anterior edge of the tibia, impaction being ev duced in this way. Massage and early mobilization sh employed in such cases.

Other bones of the tarsus are occasionally fractured, bu lesions require no detailed description.

CHAPTER XX.

DISEASES OF BONE.

Inflammation of Bone.

Considerations.—Bones are divided into the long, the short, flat, each of these consisting of compact and cancellous tissue. short bones there is but a thin layer of compact tissue sur- g a cancellous central mass, the meshes of which are filled edullary fat and connective tissue. In the flat bones the t tissue forms two limiting plates, separated by a layer of ous tissue (known in the skull as the diploe). In long bones ft consists of a tube of compact structure, surrounding a hich is normally filled with medulla, and known as the ry canal; at each end it gradually merges into a larger mass cancellous tissue, the interstices of which are similarly packed scular fatty medulla, which apparently performs the function of maintaining the nutrition of the bone, but also of elabo- he blood. Prolongations from the medulla extend into the an canals, and are thence continuous with the periosteum, so mineral skeleton has incorporated within it a vascular fibro- mass which permeates its whole structure.

ascular supply of a bone is derived (*a*) from the nutrient artery passes into the medullary space, and there breaks up into s which ramify through the whole of the medullary tissue, nce extend into the Haversian canals; and (*b*) from the peri- an exceedingly vascular ensheathing membrane, from which ssels pass perpendicularly into the Haversian canals, and a communication between the two systems. These latter are especially numerous and large close to the epiphyses. eins occur in the medullary and cancellous interior, and are ly thrombosed in inflammatory mischief; if the thrombus infected, and so disintegrated, pyæmia is very likely to ensue.

rowth of bone manifests itself in three different directions: creases in length from the shaft side of the epiphyseal cartil- epiphysis itself growing but little. In the upper limb the rease in length occurs at the shoulder and wrist, whilst in the nainly evident on either side of the knee-joint, and this in spite ct that the so-called nutrient arteries are directed away from

these points. (ii.) Increase in breadth is produced by new formation of bone from the deeper layer of the periosteum, which contains many yellow elastic fibres, and a large number of angular nucleated cells, or osteoblasts, which are presumably the bone-forming agents. (iii.) A bone increases in density by a new deposit of osseous tissue around the Haversian canals and cancellous spaces.

In considering the inflammatory affections of bones, it must always be kept in mind that the essential pathological phenomena (viz., hyperæmia, exudation, and tissue changes, active or passive) are similar to those manifested in any other vascular structure, but that the resulting effects are modified by the limited space in which the vessels lie, and the resisting character of the surrounding osseous tissue. Hence any *acute* inflammation, associated with rapid vascular engorgement and considerable exudation quickly poured out, leads to *necrosis* from thrombosis, due to increased pressure within the unyielding bony canals. If, however, the process is *subacute*, so that the tissue-liquefying properties of the exudation and the tissue-absorbing activity of the leucocytes can come into play, then *osteo-porosis* or *rarefaction* of the bone follows, a condition sometimes termed *caries*. On the other hand, if the inflammation is *chronic*, and due to causes other than tubercle or the pressure of tumours, then new formation occurs and *osteo-sclerosis*, or condensation, is most likely to result. Tubercle in bones, as elsewhere, causes primarily rarefaction of the tissue attacked, though sclerosis may be associated with or follow it, and the chronic pressure of tumours or aneurisms leads to rarefaction and atrophy locally, although a certain amount of sclerosis may be induced around.

Much needless confusion has arisen in connection with the *terminology* of inflammatory affections of bone. To all of them, whatever their nature or position, the term 'osteitis' might rightly be applied, but when the medullary cavity of a long bone is particularly affected the term 'osteo-myelitis' is substituted, as also sometimes when masses of cancellous tissue, as in the os calcis, or sheets of it, as in the diploe of the cranial bones, become the seat of an acute inflammation. The vascular continuity between the periosteum and medulla through the Haversian canals will explain why a periostitis is always associated with osteitis of the underlying bone, and why an osteomyelitis is never strictly limited to the medullary cavity.

It is also important to realize that necrosis, caries, and sclerosis are **results** of inflammation, and must neither be confounded with the pathological processes leading to them, nor described as distinct diseases.

Necrosis, or death of bone, may occur in a variety of forms, and from many different causes, *e.g.* : (*a*) From acute localized suppurative periostitis, the sequestrum or dead mass being then simply a superficial plate or flake of the compact exterior (Fig. 191); (*b*) from acute infective osteo-myelitis, the sequestrum then often involving the whole thickness of the bone, and invading more or less of the length of the diaphysis, if the condition is not early and efficiently

igs. 193 and 194): (*c*) from acute or subacute septic osteitis ous bone, the sequestra being small spiculated fragments of ancelli which have escaped absorption by the granulation ays forming in such a process; (*d*) from tuberculous disease ous tissue, the sequestrum being light and porous, often with curdy material, and rarely separated completely from g parts; (*e*) from syphilitic disease of cancellous or com-, usually resulting from excessive sclerosis, or gummatous the periosteum which has become septic: (*f*) from the ocal irritants, *e.g.*, mercury, or phosphorus fumes gaining he interior of the teeth; (*g*) occasionally as a simple senile rition, as in senile gangrene; and (*h*) a variety, described es Paget under the name of 'quiet necrosis,' occurs as a irect injury, the sequestrum separating without suppura-one of the causes of loose bodies in joints, and especially ollowing a blow on one of the condyles.

ration of sequestra is always brought about by a process to that by means of which sloughs and gangrenous materials ff from the body, viz., by complete absorption if small, d surrounded by sufficiently vascular tissue; by absorption h as possible, in larger aseptic masses, granulation tissue nd replacing the dead mass, and a line of separation form-sult of defective nutrition of the most advanced layer: or, n active rarefying inflammation occurs in the neighbouring ue, which in time breaks down, and so sets free the dead se in more detail at p. 96.) From the eroding action of ation tissue, the under surface of the sequestrum is always out, and, as it were, worm-eaten in appearance. Where resent, the process is more active, and is completed more ough with greater risk to the patient.

r, as it is sometimes called, *osteo-porosis*, or *rarefaction of bone*, l condition resulting from inflammation, and consisting in l spongy state of the bone, which, if it can be reached, aks down on pressure with a probe. It may result from ng conditions: (*a*) A simple subacute inflammatory process, g the early stage of repair in a fracture; (*b*) from acute or septic or infective inflammation of cancellous tissue; (*c*) rculous affections of the cancellous tissue or periosteum; yphilitic disease of the medulla or of the under surface of teum.

gically, it is characterized by the replacement of the by granulation tissue, which usually contains some large leated cells, or *osteoclasts*, and these seem to be closely con-th the removal of the bone. The cancellous tissue becomes out to accommodate these granulations, and the osteoclasts lly found occupying shallow depressions known as 'How-unæ.' In tuberculous and syphilitic lesions the bone cor-ften undergo fatty degeneration.

may occur with or without suppuration (*C. sicca* or *suppura-*

tiva); sometimes the development of granulation tissue is exce as when it fungates from the articular end of a bone into a (*C. fungosa*). Not unfrequently it is associated with necrosis stituting a condition of *cario-necrosis* (or *C. necrotica*), as in sept flammation of cancellous bone, minute spiculated sequestra l found in the discharge, whilst in tuberculous osteitis dead portic larger size often occur. In fact, caries and necrosis bear muc same relation to one another as ulceration and gangrene of th tissues.

If caries is recovered from, a subsequent condition of scl usually follows, with loss of substance and often deformity.

Sclerosis of bone (osteo-sclerosis) is invariably the result of chronic inflammatory affection, *e.g.*, (*a*) chronic periostitis, wh simple or syphilitic; (*b*) chronic osteo-myelitis, simple, tuberc or syphilitic; or (*c*) chronic osteitis of the compact bone, wh always secondary to one of the former. In all cases the conditi due to a slow formation of new bone within the Haversian can cancellous spaces, thus diminishing their lumen; in syphilis may progress to such an extent as to lead to their total occlu and even to localized necrosis from lack of blood-supply, espe when sepsis has occurred. In tuberculous bones the sclerosed t is always at some distance from the focus of mischief, and m looked on as Nature's attempt to limit the spread of the disea forms also the final tissue or bone-scar in the process of repair in t cases where a cure has been obtained by natural or surgical me

Classification of Inflammatory Affections of Bone.

I. **Periostitis**:
   (*a*) Acute localized, with or without suppuration.
   (*b*) Acute diffuse, always associated with or secondary to infective osteo-myelitis.
   (*c*) Chronic simple, or hyperplastic.
   (*d*) Chronic tuberculous.
   (*e*) Chronic syphilitic.

II. **Osteitis**, or inflammation of *compact* bone, which is al associated with and secondary to either periosti osteo-myelitis, and so will not be described separ The acute form results in necrosis, the subac osteo-porosis, and the chronic in sclerosis, exc tuberculous disease.

III. **Osteo-myelitis**, or inflammation of the medulla of long b
   (*a*) Acute infective.
   (*b*) Subacute simple or infective, *e.g.*, during the separa sequestra, resulting primarily in rarefaction, but in sclerosis.
   (*c*) Chronic simple, tuberculous or syphilitic, usually c general enlargement and sclerosis of the bone, e locally some rarefaction is present.

IV. **Inflammation of the Cancellous Tissue (Osteitis)** may similarly be:

(*a*) Acute infective.

(*b*) Subacute simple or septic.

(*c*) Chronic simple, syphilitic, or tuberculous.

When limited to the articular end of a bone in a young person, this is sometimes termed **Epiphysitis.**

It is unnecessary to describe in detail all these conditions, since many of the divisions overlap, and hence we shall group together the various acute and chronic affections in order to indicate the clinical signs and symptoms.

Acute Inflammations of Bone.

1. **Acute Localized Periostitis** usually arises as a result of traumatism applied directly to the bone, with or without an open wound; it may

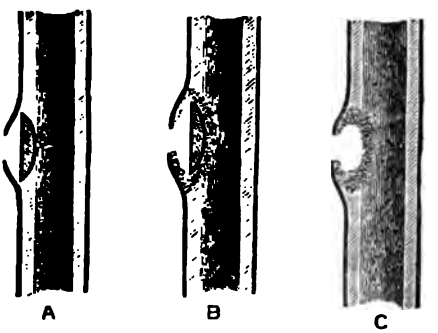


Fig. 191.—Superficial Necrosis resulting from a Localized Periostitis (Diagrammatic).

A represents the necrosed tissue lying in continuity with the surrounding living bone; the periosteum is stripped up from it, and has an opening through which the pus has been discharged. B shows a later stage, in which the sequestrum is being separated by a process of rarefying osteitis in the immediately contiguous living bone, whilst an involucrum, or sheath of new bone, is formed from the under surface of the periosteum; a cloacal aperture remains in the involucrum for the escape of discharges. C shows the condition of affairs after the sequestrum has been removed.

also be determined by general conditions, such as rheumatism, gout, and pyæmia, or by an extension of inflammatory mischief, as in an alveolar abscess.

Pathologically, the process consists of hyperæmia of and exudation into the periosteum, which becomes swollen, turgid, and thickened. This may be followed in due course by resolution, or may leave the bone thickened and in a condition of chronic inflammation; or suppuration may ensue, and with it usually a limited superficial necrosis. In the last event pyogenic organisms of no great virulence must find an entrance to the area of mischief, and probably in cases due to trauma through the abraded or injured skin; in other instances they

As soon as tension has been relieved by the escape of the pus commences. Where the mischief is very slight and superfic involved bone may entirely recover, or even small necrotic p be absorbed. If the dead portion of bone is more extensive, be separated from the subjacent living tissues by one of the pr already described (p. 96), whilst from the under surface stripped-up periosteum a casing of new bone is developed, cons an *involucrum* or sheath, at first spongy and cancellous in textu finally hard and sclerosed. In the centre of this new format found one or more openings or *cloacæ* through which the dis passes, and corresponding in position to the openings in the peri and skin made by Nature or the knife (Fig. 191, B).

Clinically, the symptoms of acute localized periostitis consis ordinary phenomena of acute inflammation, the pain being intense aching character, worse at night, and increased by lo the limb or by any kind of pressure. If a subcutaneous por bone is involved, a painful swelling develops, at first bra character, but when suppuration has occurred the centre i whilst the skin over it becomes red and œdematous. When an has burst or been opened, bare bone is felt beneath the perio and the greater part of this denuded structure usually dies, an then be either absorbed or separated ; in either case a sinus r for a time, leading down through a cloaca in the involucrum sequestral cavity. From this either pus or serum will be disch according to whether the wound has become septic or not. In five or six weeks' time the sequestrum is loose, and this i ascertained by moving it with a probe within the osseous cavity is now lined on the inner aspect with granulation tissue.

Treatment.—Rest, elevation of the limb, leeches, and fomes are usually relied on locally in the early stages, whilst a good and specific anti-diathetic remedies may be used generally. T

dly fill up with granulations, and heal completely. In many :overy may be expedited by chiselling away those portions of ıe, which must ultimately be separated, without waiting for r process of Nature; this should not be undertaken until the ve changes have ceased, and then only to a limited extent. d bone is recognised from the living by its white appearance ot bleeding when cut.

te Infective Osteo-myelitis (*Syn.*: **Acute Necrosis, Acute Diffuse ive Periostitis, Acute Diaphysitis, Acute Panostitis**).—This sually occurs in children, often of a tuberculous inheritance, ınfrequently follows one of the exanthemata (*e.g.*, measles or ver). It generally commences before the age of puberty, and fection of the gravest import; the multiplicity of names to it suggests quite accurately that its manifestations may be :rse in character.

ogy.—The patients are always in a state of depressed general ı that their germicidal powers are considerably diminished. r, spots of localized ulceration are often present in the throat, r intestines, which give a ready entrance for micro-organisms ;ystem. Evidently some of these must be circulating within l, ready to attack any area of diminished tissue resistance. injury in the shape of a strain or a wrench, which is often ıverlooked or forgotten, may suffice to determine the com-:nt of an inflammatory process which rapidly spreads by y of tissue, until perhaps the whole structure of the bone ıffected.

ıajority of the ligaments and not a few tendons are inserted epiphysis, and hence articular strain must be mainly felt in ı-epiphyseal region, *i.e.*, immediately beyond these insertions. ɔeen already mentioned that the traumatic separation of s is liable to be followed by suppuration, even in healthy and it is easy to understand that in an unhealthy child a very ury in the epiphyseal region may determine a similar process. isease almost always starts in the soft vascular tissue on the e of the epiphyseal cartilage, but occasionally it commences iphysis itself at the margin of the ossifying centre, and in a ınces (mainly amongst young adults) it may be preceded by of localized periostitis, suggesting that an acute infection has ıed upon a subacute periosteal focus. The bacteria, once l, grow and multiply rapidly, and give rise to inflammatory :na, the nature and extent of which depend largely on the uation of the infective focus, the amount of resistance offered unding tissues, and the virulence of the organisms. As in r part of the body, the trouble is most likely to travel along of least resistance.

the process commences in the periphery of the juxta-al region close to the periosteum, the line of least resistance owards that structure, and hence a *sub-periosteal abscess* may ıilst the central portions of the bone may escape almost

entirely. The extent of this abscess varies, but considerable portion of the diaphysis may be denuded, resulting in extensive necrosis. It rarely extends to the neighbouring joint, owing to the close bond of union which exists between the diaphyseal periosteum and the epiphyseal cartilage. In this variety an early incision to let out the pus may suffice to prevent necrosis, or, at any rate, to limit it. The constitutional symptoms will be less severe than in other varieties; there is less likelihood of the development of pyæmia, and the toxic fever soon disappears after the removal of the pus. Subsequently the same course of events occurs as in the localized variety of acute periostitis, viz., an involucrum forms, perforated by one or more cloacæ, and the sequestrum in time separates.

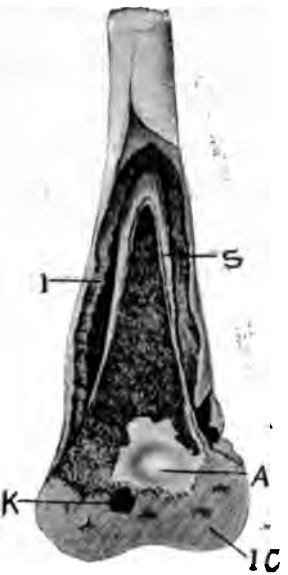


FIG. 192. — ACUTE OSTEOMYELITIS OF THE LOWER END OF THE FEMUR IN A CHILD OF NINE WEEKS. (AFTER LEXER.)

IC, Internal condyle; K, centre of ossification in epiphysis; A, abscess cavity in epiphyseal line; S, sequestrum; I, involucrum.

A good illustration of this type is to be found in the acute periostitis which affects the *lower end of the femur*. It almost always starts posteriorly, stripping the thin periosteum off the back of the bone as far as the bifurcation of the linea aspera. Its preference for this situation is evidently due to the fact that strains upon the knee-joint are mainly experienced when the limb is hyper-extended, and that such strains are directed to the posterior ligaments, and hence the posterior portion of the epiphyseal line is likely to suffer. The abscess develops, and inasmuch as it lies deeply, it is often allowed to progress for some time, one result being that the osteogenetic powers of the periosteum are always somewhat thin in this region are destroyed, so that an involucrum rarely forms in this particular example of necrosis. Removal of the sequestrum is also difficult from anatomical reasons, and hence amputation is sometimes required.

2. Should the process start in the centre of the juxta-epiphyseal region, it may spread in several directions, and the results will considerably.

(*a*) The process may reach the periosteum first, and then the phenomena of a diffuse sub-periosteal abscess, as indicated above, with the addition of the symptoms due to its deeper origin, will manifest themselves. This is, perhaps, the most usual course for the disease to take.

b) If the infection extends along the medullary cavity, the most
ical form of osteo-myelitis ensues (Fig. 192). The medulla
omes intensely hyperæmic; the veins are thrombosed; localized
of suppuration and gangrene appear; and in consequence of the
eased pressure infective emboli are likely to be detached and
mia to follow. Even if the latter does not supervene, the general
lition is profoundly affected by the absorption of toxins. Sup-
ation also occurs beneath the periosteum, although the amount
us may not be great at first; but the membrane is stripped up
the diaphysis, perhaps to such an extent as to involve the
le length and circumference of the shaft. Unless prompt
sures are taken to limit the progress of the disease, necrosis is
ain to follow, usually implicating the whole thickness of the
hysis, and sometimes its whole length. In fact, the diaphysis
ccasionally found lying loose in an abscess cavity, the two
hyses having been detached.

) It has been already mentioned that, owing to the intimate
nection between the periosteum of the diaphysis and the
hyseal cartilage, the neighbouring joint usually escapes infection.
uld, however, the epiphyseal line be within the joint, as in the
it must perforce become the seat of an acute infective arthritis
soon as the bacteria reach its periphery. The elbow-joint is
ilarly liable to suffer when bacteria attack the upper end of the
a, since the epiphysis is a mere flake of bone, and the greater
t of the olecranon is derived from the shaft. Sometimes the
ction cartilage is softened and destroyed by the organisms, so that
inflammation spreads through the epiphysis to the articular
tilage, which is eroded, and the joint opened. Occasionally the
s burrows along the soft tissues outside the bone, as along the
eps groove into the shoulder-joint.

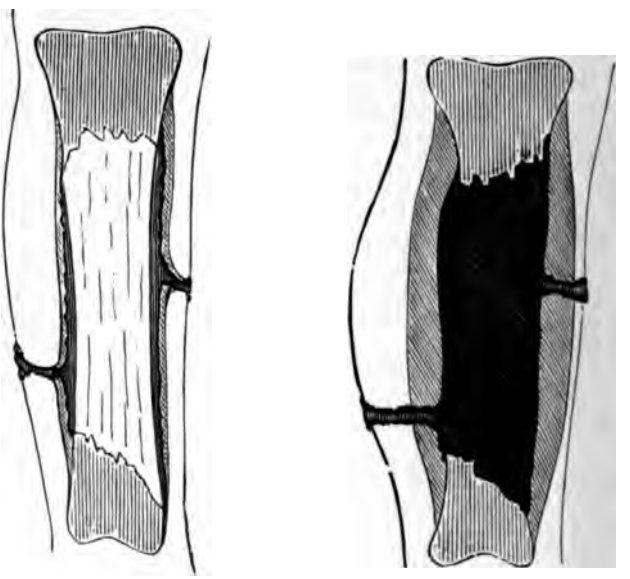
In infants, where there is little or no bone, the cartilage may be
idly destroyed, and an opening made through it into the joint,
ing rise to what was described by Sir Thomas Smith as the acute
hritis of infants.

(*d*) When the organisms are of a less virulent type, the process
y be much more localized and subacute in nature, resulting in a
nited central necrosis, or in a chronic abscess inside the bone if the
rt involved consists of a mass of cancellous tissue, as in the head
the tibia. A similar condition may affect certain epiphyses which
cur away from joints, and some chronic abscesses in such situa-
ns as the great trochanter may be explained on these grounds.
occasional result of a subacute non-suppurative osteo-myelitis is
ding of the affected bone, especially if the patient is able to put
pressure or weight on it.

The *organism* generally found in this disease is the *Staphylococcus*
pyogenes aureus, but occasionally others are responsible for it, and the
iptoms vary somewhat with the causative microbe. Thus, if due
he *Staph. pyog. albus*, the process is less acute; a good deal of
ny infiltration of the periosteum ensues, and necrosis is more

easily prevented by early treatment; this variety is sometimes termed 'periostitis albuminosa.' The *Streptococcus pyogenes*, if present at all, is only found in young children, and the resulting necrosis is often less extensive. The *Pneumococcus* has also been frequently discovered in this disease in children, as well as the *B. coli*, which latter only occurs in association with other organisms; the resulting pus is very foul.

Clinical History.—The disease usually commences abruptly with a rigor, followed by high fever and severe pain in the limb, which soon



A B

FIG. 193.—DIAGRAM OF MASSIVE NECROSIS AFTER ACUTE OSTEO-MYELITIS. (BILLROTH.)

In A (early) the necrosed tissue, though continuous above and below with the healthy bone, is surrounded by a cavity formed by the stripping up of the periosteum, and from it two sinuses pass to the exterior; in B (late) the sequestrum is supposed to have been loosened and removed, and the cavity remaining is lined by granulation tissue, and surrounded by a thick involucrum of new bone, in which two cloacæ exist.

becomes swollen, brawny, and congested. It may at first be mistaken for an acute attack of rheumatism, although the fact that the inter-articular portion is affected, and not the articulation, should readily prevent this error. The pain is of an extremely severe nature, so that the child screams whenever the limb or even the bed is touched.

Should the trouble be mainly limited to the periosteum, evidence of its being stripped off the bone, and of the accumulation of pus

t, soon show themselves. An abscess forms which may ansgress its periosteal boundary and burrow under fascial ar planes; its limitation to the dia- as been already explained; but, the neighbouring joints may escape they are very likely to suffer from exudation, and subsequently some of movements may be observed. later the abscess bursts or is opened, t to a larger or smaller amount of he subjacent bone is found bare and dead. Possibly the relief of tension e in such cases to limit the mischief, teum again becoming adherent to and a cure being established with- sive necrosis. More frequently a ole portion of the shaft loses its und has to be separated in the lready described, whilst an involu- ns around it from the periosteum 3 and 194). If a mixed infection occurred, no fever or bad consti- ymptoms need be expected during stage. Sometimes the process is so to cause actual sloughing or disin- of the periosteum, so that its osteo- wers are destroyed, and subsequent omes difficult or impossible.

he medulla itself is more especially the symptoms of pyæmia or of severe become very prominent, and the die from this cause before the local has been able to advance very con-

FIG. 194.—NECROSIS FOLLOWING ACUTE OSTEOMYELITIS. (FROM SPECIMEN IN COLLEGE OF SURGEONS' MUSEUM.)

The irregular new bone of the involucrum is well seen, and within it portions of the sequestrum.

The pain will continue to be of a aracter, although the patient's per- nay be so blunted by the toxic con- it it lies more or less unconscious. ling of the limb is not so great as mer type, but the mischief may be sive, and although there is no great of pus beneath the periosteum, yet stripped up along the whole length aft, and even detached from the epiphysis at each end. e child not die of toxæmia, extensive destruction of bone to result.

the epiphysis is attacked, the symptoms commence in the , but are likely to be followed by those of an acute sup- arthritis (p. 652). This affection is sometimes termed *acute* . It is almost limited to infants and very young children,

and is said to occur most frequently in the subjects of inherited syphilis. The head of the humerus and the upper and lower ends of the femur are the parts most commonly involved. In some of these cases the ligaments are so seriously weakened and relaxed that a loose flail-joint results.

In the milder types of osteo-myelitis, the patients complain of severe pain in one of the bones (one type of 'growing pain'), and this may be attended by some degree of fever and of local disability. The symptoms may quiet down after a time and no harm result, but in some cases the growth of the bone will be checked or entirely stopped. In other patients a subacute or chronic abscess may form and perhaps come to the surface at a later date, and on opening it a sinus is found leading to the interior of the bone, in which a sequestrum of cancellous tissue is found. In such a case the surrounding bone may at first be rarefied to such an extent as to bend under the weight of the body, but in the later stages is certain to be much thickened and very sclerosed.

The **Prognosis** of the acute form is always grave. Life may be threatened by pyæmia or toxæmia in the early stages, whilst later on hectic fever, amyloid disease, and exhaustion, may terminate the case if sepsis has been admitted.

The utility of the limb may be unimpaired if the disease has not been too extensive, and if prompt treatment has been adopted; but if life is threatened by toxæmia, or if neighbouring joints are suppurating, or if the osteogenetic powers of the periosteum have been destroyed by the acuteness of the process, amputation may be required. In cases which have recovered, excessive growth of the bones sometimes follows, owing to the long-standing hyperæmia of the part; but if the epiphyseal cartilage has been much affected the limb may be stunted in its subsequent development.

Treatment.—Prompt surgical interference must be adopted in order, if possible, to cut short the malady. As soon as the local pain and high fever give evidence that this affection is present, a free incision should be made in the long axis of the limb through the periosteum, whether pus can be detected or not. The surgeon will then proceed to investigate carefully the condition of the bones by inspection and the use of the finger and probe. As a rule, he will find himself in the neighbourhood of the epiphyseal cartilage, and if the case has been taken in hand early, it is possible that the mischief will be quite limited; all that is then required is to scrape or gouge away the softened and hyperæmic bone at the end of the diaphysis, together with any necrotic tissue which may be present, taking the greatest care not to perforate the epiphyseal cartilage. The cavity thus formed is thoroughly washed with an antiseptic; a drain-tube or gauze packing is inserted, and in all probability recovery will rapidly ensue.

If the case has gone further, the periosteum will be found stripped from the bone for a varying distance, although but little pus may be found beneath it. Under these circumstances it is always necessary to open up by gouge, drill, or cutting-pliers the medullary canal, so

ow pus to escape and the hyperæmic and gangrenous fatty ıntained therein to be scraped out. If this proceeding involves erable portion of the shaft, it may be possible to leave bridges ıct tissue here and there, scraping out the medullary cavity them. When grave constitutional phenomena are present, ɔd with loosening of the epiphysis, it will often be found ıt to amputate in order to prevent death from toxæmia.

periosteum has been more extensively involved, a large of bone, possibly the whole diaphysis, is denuded, and per- :h epiphyses are loosened. The dead diaphysis should be at once if the leg or fore-arm is involved, as there is always bone to maintain the length of the limb; but for the femur ıerus sequestrotomy should be delayed—immediate removal ad to hopeless shortening and crippling of the limb. Some ; have recommended that a bone-graft or suitable rod of or ivory should be inserted to take the place of the resected s and stimulate the osteogenetic powers of the periosteum; no objection to such an attempt being made, provided that s maintained, but it is very questionable whether much good w.

there is any doubt as to the actual condition of the bone, symptoms indicate that the medulla is not much involved, diate removal is undesirable; the pus is allowed to escape a free incision, the cavity is well irrigated, and the stripped- steum allowed to fall back upon the bone, and regain adhesions ossible. Drainage is provided for, strict asepsis maintained, discharge soon becomes merely serous. A portion of the s, and during its separation from neighbouring parts becomes in a newly-formed involucrum. When the sequestrum is at is, in about five or six weeks—*sequestrotomy* will be required; ts in reflecting the periosteum from the new casing, and in g or uniting one or more of the cloacæ, so as to allow the um to be withdrawn; it sometimes expedites matters to ıe sequestrum into two portions, and then to deal with each ly. The cavity thus left is well irrigated, and either drained ɔd with gauze, so as to allow it to heal from the bottom by ion. Occasionally the operation for removal of the seques- exceedingly difficult and dangerous, owing to the situation of ses, and in some places, *e.g.*, the posterior aspect of the lower he femur, it is almost impracticable to reach it; under such tances *amputation* may be preferable. This summary proceed- also be needed in the course of this disease on account of , defective repair, exhaustion from chronic sepsis, or suppura- ı neighbouring joint.

ıe **Acute Septic Osteo-myelitis** which arises as a result of ı from without, *e.g.*, in cases of compound fracture, and after tion, excision, or even osteotomy, requires a separate descrip- The clinical history of a case involving the shaft of a long as follows: The patient during an attack of septic traumatic

fever due to an injury or operation has one or more rigor suggest the existence of pyæmia, and is suddenly seized wit pain in the limb, which becomes intensely sensitive. On ex the wound, the soft parts are found t healthy and infiltrated, the lower end of is bare and yellow, and from the in stinking mass of gangrenous medullar sometimes protrudes. Should early and treatment not be undertaken, the pati a considerable risk of succumbing to py septic intoxication, whilst a varying ar the interior of the bone dies (*central n necrosis*), and a small segment of its wh ness below, so that the sequestrum ultimately separates is annular and (Fig. 195). Should the patient surv necrotic tissue gradually separates, and this process a mass of new bone is form the under surface of the periosteum, so shaft becomes much thickened externa the slighter cases a mass of granulations from the medullary cavity of the divi of the bone, and in this there may be t formed bony substratum.

FIG. 195.—TUBULAR OR CONICAL SEQUESTRUM FROM SEPTIC OSTEO-MYELITIS AFTER AMPUTATION.

Treatment.—The wound is thoroughly up as early as possible, flushed out, sloughing medullary tissue scraped f interior of the bone, which is subs disinfected with pure carbolic acid, a dr or gauze wick being placed in it for a fe A certain amount of necrosis follows, b out high fever or toxæmia. Should this treatment fail, am will be required.

A similar process may also invade the *short bones*, and the ca extremities of long bones, being often secondary to septic i or to a compound fracture involving such parts. The l general phenomena are very similar to those detailed above that no large sequestra are formed, the dead bone coming small spicules (one form of *caries necrotica*), whilst the pain a are less severe, and there is less likelihood of the develop pyæmia. *Treatment* consists in free drainage, removal of th tissue, and efficient purification of the wound.

TYPHOID OSTEITIS.

Affections of the osseous system are not uncommon in typhoid f usually come on about the third week or during the early stages of conv The tibia and ribs are most often affected, and in a large percentag typhoid bacilli, with or without pyogenic cocci, will be found. It is note how long the organisms may lie latent in the tissues before a abscess—in one case (Sultan's) for six years. The trouble commences

so-myelitis, subacute in character, often improving for a time, and It often develops an abscess, and then some amount of necrosis llow; thus in a case recently operated on by one of us a con-trum was removed from the upper third nilst in the opposite leg there had been an nilar position, but without death of bone. ubacute or chronic, and the affected bone rather than necrotic. On its first appear-d limb should be elevated and fomented, he more acute symptoms will yield; but emains enlarged, swollen, and tender, and pain are not unlikely to occur from time r later leading up to the formation of an suppuration has occurred, the parts must , diseased bone removed, granulation tissue and the parts disinfected with liquefied The wounds are usually found to be ex- and indolent, and may require scraping

FIG. 196.—CHRONIC OSTEO-PERIOSTITIS OF TIBIA, SHOWING THE FUSIFORM SWELLING ON THE FRONT OF THE BONE, CONSISTING OF DENSE OSSEOUS TISSUE, AND THE MEDULLARY CAVITY ENCROACHED UPON. (MUSEUM OF ROYAL COLLEGE OF SURGEONS.)

IC INFLAMMATION OF BONE.

teo-periostitis.—By this disease is onic inflammatory condition of the esults in overgrowth, thickening, and

(*a*) It may arise as a *localized* chronic umatic, rheumatic, or syphilitic in to the close proximity of a chronic haracterized by a formation of new the periosteum, the so-called *node* The cancelli are arranged at right surface, in consequence of the new around the small vessels, which enter the under surface of the periosteum. ew material is soft and spongy, but it es hard and sclerosed, and a similar cts the subjacent compact structure, ened and indurated by a new forma- e Haversian canals. If the irritation the case of a chronic ulcer, this con- n on into the following variety.

use form of chronic osteo-periostitis ates in some deep-seated or central rculous or syphilitic in nature, and lve the whole bone, although it is nited to one or other end. If tuber- may be a small abscess or some is, and around this focus of prolonged bone becomes thick and indurated. tages a considerable new formation neath the periosteum, and the medul- come entirely obliterated. If syphilitic in origin, it may

be due to a central gumma, or a general condition of sclerosis *may* supervene without any localized focus.

The **Symptoms** consist of deep aching pain in the limb, worse in bed, with perhaps tenderness over some particular spot. This latter condition is especially evident in cases where an encysted abscess exists in the head of a bone, such as the tibia. On examination the bone is felt to be thickened, and its surface more or less nodulated. If the disease is limited and superficial, a distinct node may be felt, consisting of a hard, fusiform, and tender swelling. Where the enlargement is more general, there is less tenderness, though the pain is constant.

The **Diagnosis** of such cases is not always easy, the enlargement of the bone being sometimes mistaken for the *early stage of a malignant tumour*. The rate of growth will be of little assistance, since it is very variable; but a tumour may have more defined limits, and its tension is often not the same throughout. Skiagraphy is valuable in this direction, since in simple chronic periostitis the bone is solid and throws a continuous and well-defined shadow, while in malignant disease a certain amount of soft tissue is sure to be present, either centrally or peripherally, easily penetrated by the rays, and hence leaving gaps in the shadow. If, in spite of such assistance, the case is still doubtful, an exploratory incision will be required.

The **Treatment** at first consists in resting the limb, applying counter-irritation (*e.g.*, iodine paint or the actual cautery), and giving iodide of potassium internally. If relief is not thereby obtained, an *operation* will be necessary. An incision is made over the whole length of the thickened bone through the periosteum, which is stripped aside, and if merely a nodular enlargement is present, the new formation is chiselled away. When the whole thickness of the bone is involved, a gutter or trench must be made by gouge and mallet, extending into the medullary cavity, and its length corresponding to the enlargement. The soft parts are then loosely drawn together and the wound dressed; the hollow will fill with blood-clot, and this is allowed to organize (p. 251). If enough bone has been removed, most satisfactory results follow; but in some aggravated conditions which have lasted for many years amputation is required.

Tuberculous Diseases of Bone.

Bone may be affected in two ways by tubercle, either the periosteum or the cancellous tissue being primarily involved.

1. In **Tuberculous Periostitis** a specific infiltration of the periosteum is met with, consisting of a deposit, partly in that membrane and partly under it, of pulpy granulation tissue containing the characteristic miliary tubercles, which are chiefly developed around the vessels passing from the periosteum into the bone. As in tuberculous disease elsewhere, caseation and suppuration are likely to follow, leading to the formation of abscesses, which are primarily subperiosteal and filled with curdy pus; these in time find their way

to the surface, either directly or by more or less tortuous channels, and leave sinuses, extending down to the bone. The final effect of such a condition depends largely on whether the subjacent bone consists of thick or thin compact tissue. If the compact bone is *thick*, the disease is usually localized to the part first affected, the surface of the bone escaping entirely, except some slight superficial erosion. Occasionally, however, the disease may spread along the periosteum, and involve a neighbouring epiphysis or joint. If the compact bone is *thin*, as in the bodies of the vertebræ, the underlying cancellous tissue is almost certain to be secondarily affected.

Clinical History.—In the early stages a somewhat diffuse elastic pulpy swelling forms over the bone, which is slightly tender on pressure. It takes some weeks or months to develop, and on skiagraphy the underlying osseous tissue may appear quite normal in texture. In the latter stages, when caseation or suppuration is present, the swelling often becomes more defined and its surface nodulated; it then somewhat resembles an ordinary node, but is usually more irregular in shape, of somewhat unequal consistency, and on firm pressure small portions may be felt to give way. If an abscess forms, the pain becomes greater, but it diminishes as soon as tension is relieved by discharge of the pus. The admission of sepsis, however, increases the trouble. It is probably seen in its most typical form in connection with the ribs or sternum.

Treatment.—In the early stages, constitutional treatment may suffice, together with rest and carefully-adjusted pressure, as by strapping with Scott's dressing. The condition, however, demands incision if a neighbouring joint is threatened, or when suppuration has occurred. Free removal of all the granulation tissue and softened bone with a Volkmann's spoon is required, disinfection of the cavity with undiluted carbolic acid, and stuffing it with gauze soaked in a sterilized emulsion of glycerine and iodoform (10 per cent.), the wound being allowed to granulate from the bottom. In dealing with the ribs, complete excision of the affected portion is advisable.

2. **Tuberculous Osteitis** always arises in cancellous tissue, and it affects the short bones, or the shafts or ends of long ones.

(*a*) The *short bones of the hands and feet* are very liable to this condition. It occurs in weakly children with a tuberculous inheritance, or in those whose general health has been depressed by one of the exanthemata, or sometimes in those otherwise healthy. Some slight injury may determine the onset of the attack, which frequently involves several bones simultaneously. When the phalanges are involved, the disease is known as **Tuberculous Dactylitis.**

Clinical History.—The affected bone becomes slowly enlarged, expanded, and painful, the pain being, however, slight in amount, though sometimes worse at night. This continues for some time, until finally one spot rapidly increases in size, becoming red and tender, and finally an abscess forms, which bursts or is opened, leaving a sinus, down which a probe can be passed into the carious interior of the bone. Occasionally contiguous joints are involved in

this process, whilst the tendon sheaths are also liable to be affected; a large portion of the swelling is due to periosteal infiltration (Fig. 197).

Pathology.—A deposit of tubercle bacilli occurs in or around the bloodvessels in the interior of the bone, which may have been previously rendered somewhat hyperæmic as the result of an injury. The organisms produce their usual effect, viz., transformation of the normal medullary tissue into pulpy granulation tissue containing tubercles, the bony cancelli becoming meanwhile eroded and rarefied, and the bone corpuscles undergoing fatty degeneration (*vide* Caries, p. 571). Sequestra occasionally form, but more often in adults than in children, owing to the greater density of the bone in the former. They are due to a cutting-off of the blood-supply of a definite portion of the bony tissue, either as a result of tuberculous endarteritis, or from early caseation within the cancelli of the whole of the granulation tissue. The sequestra are soft and friable, usually yellowish white in colour from the presence of the caseating tissue in their substance, and are seldom completely separated from the surrounding bone; thus, they are often quite clear superficially and laterally, but adherent on the deeper side. When the tuberculous disease does not involve the whole bone, the nearest healthy tissue may become sclerosed, and thus one not unfrequently finds a central sequestrum surrounded by rarefied bone which merges into an area of sclerosed tissue. When a tuberculous focus becomes septic, the destructive process increases in rapidity, and minute spiculated sequestra often come away in the discharge. The term expansion of bone used above is scarcely correct, inasmuch as the enlargement is due to absorption on the inner aspect, whilst there is a new formation of bone under the periosteum. Skiagraphy is a useful adjunct in estimating the amount of disease present, since the affected bone is less dense, and consequently light areas appear in the midst of the dark shadow cast by the bone (see Plate XXVI.).

FIG. 197. TUBERCULOUS DACTYLITIS. (ROYAL COLLEGE OF SURGEONS' MUSEUM.)

This disease started in the proximal phalanx, and has perforated it anteriorly, the tuberculous material having involved the periosteum and tendon sheath, whilst the first interphalangeal joint is becoming invaded. There is also a considerable formation of granulation tissue on the dorsal aspect.

The **Treatment** of tuberculous dactylitis in the early stages con-

PLATE XXVI.

TUBERCULOUS DISEASE OF RADIUS.

nt was a lady over fifty years of age, who had suffered for some months pain and swelling of this bone. The site and extent of the disease is ated by the light area in the shadow of the bone. Eventually amputa- was required.

sts in attention to the general health, together with rest locally, and rhaps strapping the parts with Scott's dressing. Should the disease ogress in spite of such measures, operation must not be unduly layed, since neighbouring joints and tendon sheaths are very likely be attacked. An incision is made down to the bone at some table spot where tendons or other important structures will not be ured; the periosteum is divided, and the outer layer of compact e removed by gouge or trephine, so as to allow the diseased dulla to be scraped away with a Volkmann's spoon. When all tuberculous tissue has been eliminated, the cavity thus produced wabbed out with liquefied carbolic acid, any excess being washed y with absolute alcohol; the wound is then stuffed with gauze ed in iodoform emulsion, in order to ensure healing by granula-. Unless this scraping is thorough, recurrence is very likely to e, but the integrity of epiphyses and of articular cartilages must espected. When an abscess or a sinus exists, the same measures st also be adopted. Not unfrequently the growth of the bone is y considerably hindered, either by the disease or by the treatment uisite in order to eradicate it, and the part becomes stunted or ormed in consequence.

b) Any of the *bones of the tarsus* may be involved in exactly the ne manner, the clinical history and treatment being identical, hough possibly articular lesions are somewhat more common than hen the disease is limited to the phalanges. The affected portion the foot becomes swollen, shiny, and pulpy, since the overlying riosteum is often involved in the process; and it is sometimes ifficult to determine whether the lesion is limited to the bones or lso involves the joints. In the early stages one part of the foot ay be more swollen than another, according to the location of the rouble. The os calcis is most often affected, and afterwards, in rder of frequency, come the first metatarsal, astragalus (the head), nd scaphoid. When it starts in the astragalus, the swelling occurs below the level of the ankle-joint in front of or behind the malleoli, whilst pressure over the head of the bone gives rise to pain. The oot is usually in a position of equinus, but not to such a marked legree as when the ankle-joint itself is affected; the subastragaloid novements (inversion and eversion, abduction and adduction) are lso considerably limited, or may be absent. An examination of the ccompanying illustration (Fig 198) will explain the fact that tuber-ulous disease starting in the astragalus is very likely to involve the nkle-joint, or to spread to the os calcis or scaphoid. Disease of the calcis leads to more limited swelling of the back of the foot on one both sides of the heel; the movements of the ankle will not be paired, although walking is painful, and hence the patient limps, ading only on the toes. Further forwards tuberculous disease is st likely to start in or around the scaphoid, the bulbous swelling the foot being then shifted anteriorly, and the movements of the le remaining unimpaired. The prognosis is much worse when disease attacks the inner half of the foot, comprising the astra-

galus, scaphoid, cuneiform, and three inner metatarsal bones, owi
to the arrangement of the synovial membranes, than when it affec
the outer segment, consisting of the cuboid and two outer metatarsa
which are excluded from the general synovial membrane, and a
thus more amenable to treatment.

Sooner or later suppuration occurs, with increased pain, an
should the sinus which results from opening the abscess beco
septic, the trouble is sure to spread much more rapidly, and t
prognosis becomes increasingly grave.

Treatment is conducted according to the rules which always gu
us in that of tuberculous disease. In the early stages the foot a
ankle are immobilized, and preferably in plaster of Paris or wa
glass. The child is sent to the seaside, and plenty of good f
administered, and it is not allowed to walk until all pain has ceas
even then the plaster case must be retained until the swelling

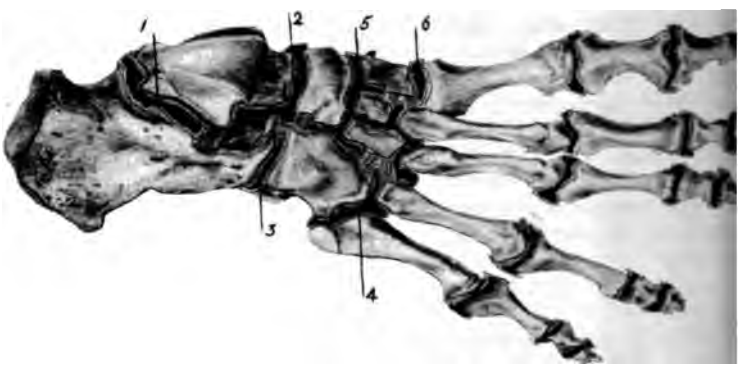


FIG. 198.—ARRANGEMENT OF SYNOVIAL MEMBRANES OF FOOT.

1, Posterior calcaneo-astragaloid, behind the interosseous ligament; 2, ante
calcaneo-astragaloid and astragalo-scaphoid; 3, calcaneo-cuboid; 4, ca
metatarsal; 5, the large common sac between scaphoid and cuneifo
between the cuneiform, and between the cuneiform and second and th
metatarsals; 6, between the internal cuneiform and first metatarsal.

entirely disappeared. It is wise to remove the plaster every mon
or two for inspection and re-adjustment.

Should the disease persist in spite of such treatment, or sho
suppuration occur, removal of the tuberculous tissue by operati
may be required. If the *os calcis* alone is involved, it will usua
suffice to open well into it either from one or both sides, to scra
out its interior, and then pack it with iodoform and gauze after d
infecting it with liquefied carbolic acid. Decalcified bone chips mix
with iodoform have been packed into the cavity in order to hast
bony consolidation, but not with much success; in any case t
interior of the bone becomes occupied by fibrous tissue, with perha
a few bony spicules, and a marked permanent depression alwa
remains at the site of operation. Excision of the os calcis w

formerly practised, but is not to be recommended, since even if performed subperiosteally, the power of repair that remains is very slight. If the disease mainly affects the *astragalus*, it may suffice to remove it entirely, neighbouring articulations being curetted, if need be; but probably the disease will have spread so far that amputation will be required, and then Syme's operation is better than methods, such as Pirogoff's, which retain any portion of the tarsus. Disease of the *cuboid* and outer half of the foot in front of the os calcis can often be dealt with efficiently by scraping, but when the common synovial membrane on the *inner side* is involved, amputation will probably be required, failing success by conservative measures.

(*c*) If the tuberculous disease affects *the ends of long bones*, it most commonly starts in the epiphysis, or under the articular cartilage, though sometimes on the shaft side of the epiphyseal cartilage. The changes already described take place, and lead to early destruction of the latter cartilage, so that the adjacent parts of both epiphysis and diaphysis become involved (**tuberculous epiphysitis**). The general signs are similar to those present when the smaller bones are affected, but the results produced may vary considerably. (i.) In the slighter forms, where efficient treatment is adopted, the tuberculous tissue may be totally absorbed, and the process thus comes to an end, though the affection of the epiphyseal cartilage may lead to subsequent impairment of growth. (ii.) In others it may be circumscribed by the bone becoming sclerosed around a caseating focus, and then, if suppuration ensues, a *deep abscess in the end of the bone* may be produced (Fig. 199). Such is rarely of large size, containing at most 1 or 2 drachms of curdy pus, and is lined by a definite pyogenic membrane of the usual tuberculous type. The effects produced by this condition are similar to those of chronic osteo-periostitis, viz., a deep aching or boring pain in the bone, worse at night, together with enlargement of the affected part, whilst one spot is often very tender on palpation. If it has existed for any length of time, the whole shaft may become enlarged as a result of chronic osteo periostitis (p. 584). (iii.) The disease may burrow along the epiphyseal line, and find its way into the neighbouring joint, if the epiphysis is intra articular, as in the hip; but if the epiphyseal cartilage is placed beyond the limits of the capsule, a subperiosteal extra-articular abscess will develop (Fig. 200). Should the disease spread equally in all directions, the epiphysis may actually be separated. (iv.) A more common result is for the whole or part of the cancellous tissue of the epiphysis to become involved, and the joint to be secondarily affected with tuberculous arthritis, either by perforation, erosion, or necrosis of the articular cartilage, or by extension to the synovial membrane around its margins. (v.) The process may sometimes extend upwards along the medulla into the shaft, causing a diffuse osteo-periostitis, with or without a medullary abscess (Fig. 201).

The **Treatment** of tuberculous epiphysitis is conducted in the first place by absolute immobilization and hygienic measures; but the surgeon must not be tempted to trust too long to such a régime, for

FIG. 199.—CHRONIC ABSCESS IN THE LOWER END OF THE TIBIA. (KE COLLEGE HOSPITAL MUSEUM.)

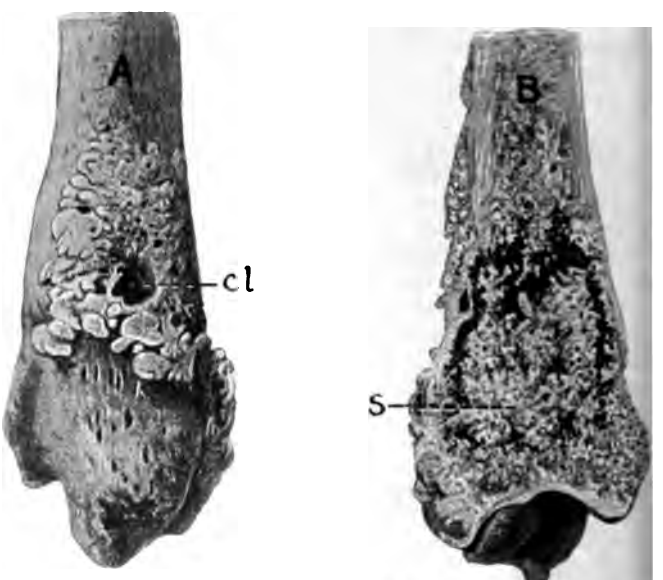


FIG. 200.—LOWER END OF TIBIA AFFECTED WITH TUBERCULOUS DI (KING'S COLLEGE HOSPITAL MUSEUM.)

In A, a subperiosteal deposit of new bone is seen surrounding an openin which leads into the interior of the bone; in B, the interior of the same is seen, and shows a sequestrum (S) just above the epiphyseal line. ankle-joint is healthy.

fear of the joint becoming also affected. If considered necessary, an opening is made into the interior of the epiphysis, and all the pulpy granulation tissue, caseous débris, or diseased bone removed with a sharp spoon, the cavity being subsequently disinfected, and stuffed with gauze infiltrated with iodoform. Of course, the utmost care must be taken not to open the joint by scraping through the articular cartilage. Where a chronic abscess exists in the end of a bone, a trephine should be applied over the tender spot, and, if the

FIG. 94.—LOCALIZED ABSCESS IN THE LOWER END OF THE FEMUR, EXTENDING FROM THE EPIPHYSEAL LINE UPWARDS INTO THE MEDULLA. (FROM SPECIMEN IN THE COLLEGE OF SURGEONS' MUSEUM.)

cavity is not at first opened, the bone may be drilled in different directions to ascertain whether or not pus exists.

(*d*) The *medullary canal* of the shaft of a long bone sometimes becomes the seat of tuberculous disease; this, as also the abscess of bone described above, is more common in adults than in children. The part thus affected becomes carious, with or without the formation of sequestra or pus; but the most marked feature of this deep-seated central trouble is that the whole bone passes into a state of chronic inflammation, which we have described, as well as the treat-

ment necessary for it, under the title of chronic diffuse osteo-ostitis (p. 584).

Syphilitic Diseases of Bone.

The osseous tissues may be involved in acquired syphilis in either the secondary or the tertiary periods.

In the **Secondary Stage** flying pains about the bones (sometimes termed *osteocopic*) are often complained of; they are, however, of little importance, and disappear rapidly as the patient gets under the influence of mercury. In the late secondary or early tertiary periods, a *periosteal node* is often met with, as a result of chronic periostitis. It usually affects only one bone, and most commonly the tibia, and consists of an infiltration and thickening of the periosteum, which may entirely disappear, but later on is accompanied by a formation of new bone. This is at first spongy and soft in character, but after a while becomes hard and sclerosed; the Haversian canals are always placed at right angles to the subjacent osseous tissues. When such has once occurred, absorption of the newly-formed bone does not readily follow, even under treatment, the part perhaps remaining permanently thickened. It is recognised clinically as a fusiform swelling, a little tender on pressure and the seat of deep aching pain, usually worse at night. It must be understood that the pain is not so much associated with the onset of night as with the increased warmth of the limbs when in bed; indeed, patients with syphilitic tibiæ frequently sleep with the legs exposed. Night-watchmen and others, on the contrary, complain of pain during the day, when they take their rest. Suppuration does not often occur, and constitutional rather than local treatment is required.

In the **Tertiary Period** the bones may participate in the changes which involve any and every tissue of the body. These consist in infiltration and overgrowth of the connective tissues, which if diffuse through an organ produce sclerosis, if localized to one spot lead to the formation of a gumma. Hence the following lesions are met with:

(*a*) The formation of *subperiosteal gummata*, either localized or diffuse, probably resulting in *caries* of the subjacent bone; if the affection be limited, only a small portion may be thus involved; but where it is widely diffused, an extensive surface of the bone may become eroded and irregular. This process is sometimes accompanied by a development of new bone under the adjacent periosteum, and is very often complicated by sclerosis and necrosis. The calvarium is the bone most frequently involved in this change, but, owing to the osteogenetic powers of the pericranium being small, there is rarely much new formation of bone in the neighbourhood, and thus the skull will present a curious worm-eaten appearance (Fig. 202). Frequently the gummata break down and destroy the superficial scalp tissues, leaving deep and extensive wounds, discharging an abundance of foul pus, the bottom of which bare and even dead bone may be felt.

(b) At the same time a condition of *sclerosis* may be produced in the underlying or surrounding parts, and this may progress to such a degree as seriously to compress and constrict the vessels in the Haversian canals. Moreover, an obliterative endarteritis is almost always present, and these factors, combined with the separation of the periosteum by the above-mentioned gummatous changes, so interfere with the vitality of the bone that, should sepsis occur in the broken-down gummata, necrosis is almost certain to ensue, especially in the skull.

The effects produced vary considerably in different cases, and especially with the situation. When the *calvarium* is attacked, septic phenomena are commonly present, and necrosis is a usual accompaniment of the gummatous changes. The process in such a case,

Fig. 202.—Syphilitic Caries of Skull from Diffuse Gummatous Disease (From King's College Hospital Museum.)

as is represented in Fig. 203, would probably be as follows: The pericranium corresponding to the necrotic area became gummatous, and at the same time the subjacent bone underwent sclerosis. Sooner or later the gummata burst or were opened; septic changes supervened, and the scalp tissues were stripped off the calvarium to the limits of the disease, necrosis resulting in the sclerosed area of bone. A line of rarefaction subsequently formed around the sequestrum in consequence of Nature's attempts to separate it. The disease is marked by its extreme chronicity, the sequestrum lying bare in the wound perhaps for years without being separated, owing to the slight degree of vascularity and the extreme condensation of the surrounding parts. Moreover, as explained above, there is an entire absence of an involucrum. In the *shafts of long bones*, where the compact tissue is thick and resistant, there may be extensive periosteal disease, with but little affection of the underlying parts; but if this compact layer is thin, and especially when the cancellous ends are involved, a considerable amount of destruction from caries may result, though if epsis is not admitted there will be an entire absence of necrosis.

In the **Treatment** constitutional remedies, in the form of iodide of tassium and mercury, should, if possible, be depended on. Gum-

mata should never be opened without the strictest at
asepsis. If sepsis has occurred, the wounds may be
applying iodoform and dressing with sterilized gauze steep
nigra, or covered with mercurial ointment. Counter-op
often required for purposes of drainage, especially in
Necrosed portions, when separated, are to be remove
tissue may be scraped away with a sharp spoon, and t
powdered with iodoform and dressed antiseptically. In the
no attempt must be made to chisel away the dead bone.

(*c*) Occasionally
matous osteo-myeli
with, in which
forms in the int
bone. It results
called expansion o
secondary thicke
enlargement of
structure, *i.e.*, a dif
periostitis. The
are the same as
scribed for the latte
and if it resists th
tration of anti-
remedies, it must
in the same way
separation of the p
freely opening the
cavity, and removi
eased tissue. Th
when affecting
bones have often
taken for malignan
necessarily, it is a
the most vital imp
come to a right co

FIG. 203.—SYPHILITIC NECROSIS OF THE SKULL. (KING'S COLLEGE HOSPITAL MUSEUM.)

The sequestrum is becoming separated, and a ring of caries is forming around it.

to their nature. The greater rapidity of growth in the
cases, and the evidences of syphilis elsewhere, or of a
history, will often guide the surgeon to a right conclusi
there is any doubt an exploratory incision should alway
before amputation is undertaken.

In **Inherited Syphilis** any of the above manifestations m
but with more or less special features added, and, in additio
certain forms which do not occur in the acquired type of t
have been described.

1. A new formation of bone beneath the periosteum is p
most frequent result, and this occurs with but little pain.
the most common situation of this lesion in infants is the
where bony masses known as *Parrot's nodes* form around th
fontanelle, causing the top of the skull to resemble a 'hot

In the early stages the bone is soft and spongy, and on
m examination is dark red or maroon in colour. If the
ot checked by suitable antisyphilitic treatment, the newly-
ous tissue becomes dense and sclerosed, and the deformity
persist through life (Fig. 22, p. 154). Any part of the
may, however, be affected, and the change is not neces-
ed to the first years of life.

ilar condition is met with in the shafts of long bones, due
sition of alternating lamellæ of soft and hard bone outside
y compact tissue.

itic epiphysitis (or, as it is termed, syphilitic *osteo-chondritis*)
characterized by enlargement of the ends of the bones,
ı infants, and somewhat resembling rickets, but coming
arlier date. The enlargement is mainly situated in the
ut not uncommonly extends some way along the shaft,
sting forcibly with rickets. Occasionally only one side
hysis is affected. The change commences in the zone of
tilage nearest the diaphysis, which becomes friable, opaque,
r, and as the condition progresses it may be transformed
ation tissue, so that separation of the epiphysis follows.
ı sometimes results in suppuration and acute arthritis, or
ngs powerless in a condition known as *syphilitic pseudo-*
The disease is usually symmetrical, and often multiple,
d in much the same positions as rachitic affections, the
ws, and wrists being perhaps most often affected.

metrical overgrowth of the tibiæ, perhaps combined with
curvature, also occurs in syphilitic children, resulting in
elongation of the legs (p. 442).

tabes consists of a localized absorption of the osseous tissue
ium, leaving small areas where the bone is thinned or
hat on pressure a sensation of crackling, like that of
is imparted to the finger. It occurs most frequently in
l bone (in 60 per cent. alone; in 95 per cent. with other
*penter**), and in the majority of cases within the first six
fe, a fact that throws considerable doubt on the idea that
rickets.

tment of syphilitic lesions in children must be carried out
ce with general principles, and mainly by the administra-
ible drugs.

Rickets.

s a general disease of malnutrition, occurring in children,
sting itself mainly in lesions connected with the bones.
commences within the first three years of life, but some-
ars later.

-Any and every fault in the hygienic and dietetic treat-
child seems capable of inducing rickets; but the most

r, 'Syphilis of Children in Every-day Practice.' Baillière, Tindall
01.

important factor in its ætiology is insufficient or improper food, esp
cially the too early administration of starchy materials, whilst u
cleanliness and want of air and light also predispose to it. Prolong
lactation is not necessarily a cause, if the mother is healthy a
capable of feeding the child; but amongst poor patients this ha
is frequently responsible for its appearance, although in Japan, wh
the children are suckled for two or three years, the disease is u
known. Rickets is common in the poorer classes, who are herd
together in small and badly-ventilated rooms, and is so peculia
frequent in this country as to be known in Germany as the 'Engl
disease' (*Englische krankheit*).

The **Symptoms** may be divided into the early or general, and t
later or osseous. The *general* symptoms are mainly referable to
state of irritability of the gastro-intestinal mucous membrane. T
child may be fat and flabby, or thin and emaciated; the muco
membranes are pale, and vomiting and diarrhœa are constan
present, the motions being often green, slimy, and very offensi
The spleen is enlarged, the abdomen tumid, and profuse sweati
of the head is very characteristic.

The commencement of the *osseous changes* is usually indicated
increasing irritability and restlessness, the child tossing off his b
clothes at night, and crying out when handled or touched. T
articular ends of the long bones become enlarged, as also the junct
of the costal cartilages with the ribs. Sooner or later the shafts
the long bones soften, and may bend in various directions, and th
many *deformities* may be produced.

The *head* usually becomes flattened antero-posteriorly, so t
the forehead appears square in shape and enlarged, whilst fro
bosses may develop on either side, due to new formation of b
under the periosteum; it is a question, however, whether these
not syphilitic rather than rachitic in origin. The fontanelles rem
open much longer than usual, and craniotabes is said to occur. T
teeth do not erupt till late, and are stunted, defective in enamel,
easily eroded, so that the ends of the incisors are often concave; th
must not be mistaken for syphilitic teeth, since the concavity
small arc of a large circle, whilst the typical notch of syphili
a large segment of a small circle.

The *spine* may be affected by kyphosis (p. 428), or less freque
by scoliosis (p. 423); the kyphotic curve results when the pat
is allowed to lie too much in bed with the head on a high pill
or if it is carried about with a curved back; scoliosis more o
occurs when the patient is able to walk. Occasionally the
conditions are associated in the same child, a kypho-scoliosis re
ing, which is usually due to its being carried about sitting o
nurse's arm with the pelvis tilted.

Changes in the *thorax* are produced by enlargement of the co
chondral junctions (*beaded ribs*), which, when present on either
of the sternum, produce what is known as the *rickety rosary*. If th
is any obstruction to the entrance of air into the lungs, as

or bronchitis, the atmospheric pressure may cause the one and cartilage to sink inwards, and as a result of this the ıay be pushed forwards (*pigeon breast*), whilst the curvature ; at the angle is increased. A very characteristic feature of · change consists in the lateral groove thus produced on each sternum, which may meet nsverse depression below, r the projection of the by the tumid abdomen. *is* is flattened antero-pos- r more rarely triradiate, condition being produced patient lies habitually on the latter only occurring s allowed to walk about, ›ula being thus pressed ınd backwards by the ıe femora.

ormity of the *long bones* usually consists in an n their natural curves, at points where powerful e attached. The femora l antero-posteriorly, and in a similar direction, here is often some lateral nt superadded. Most the lower end of the ent inwards—*i.e.*, in a opposite to that repre-

FIG. 204.—PELVIS AND LEG-BONES IN RICKETS. (FROM COLLEGE OF SURGEONS' MUSEUM.)

Fig. 204. Genu valgum nay also result from the changes.

ne acute stage of rickets l away, any deformities come fixed by the com- ication of the softened s. As a rule, the density formed bones is increased, r natural shape is altered ts of new subperiosteal struts in the concavities, section they are usually more or less flattened from side rowth is often checked by this disease, so that the individual tunted and dwarf like.

dically, the chief changes in rickets are found in the neigh- of the epiphyses. Ordinarily, the epiphyseal cartilage is a out a line in thickness, bounded on either side by a zone d tissue, containing regular alveolar spaces filled with

vascular medulla, and lined by osteoblasts, shelving grad
normal cancellous bone. In rickets the epiphyseal cartil
only circumferentially enlarged, but also thickened and
(Fig. 205), outgrowths of cartilage projecting on either sid
calcified tissue, which is more abundant and more open
than usual, whilst it passes irregularly into the cancell
Thus, there is an increase in the material which Nature pr
the formation of bone, but the ossifying process is inefficien
out. In addition to this, the Haversian canal systems
medullary spaces in the diaphyses are enlarged, so that

FIG. 205. — SECTION THROUGH LOWER END OF RICKETY RADIUS, SHOWING EXAGGERATED DEPTH AND IRREGULAR BORDERS OF THE PROLIFERATING EPIPHYSEAL CARTILAGE.

FIG. 206.—TRANSVERSE SECTIO THE SHAFT OF THE ULN RICKETY CHILD OF THIRTEE (× 10), SHOWING SPONGY TISSU THE PERIOSTEUM INSTEAD OF PACT TISSUE OF NORMAL BO

(From Ashby and Wright's 'Diseases of Children.')

become weaker and less rigid from the insufficient amou
salts present, and thus readily bend under the weight of
or from muscular action. Less frequently the subperiostea
bone becomes similarly rarefied (Fig. 206). When the dise
to an end the deformities may persist, and the bone becon
and stronger than usual, the medullary canal being often
in the long bones, and displaced towards the convex si
curve.

In the **Treatment** of rickets the most essential feature in the early stages is the correction of all errors in the personal hygiene. The diet should consist of good cow's milk, diluted if need be, and with lime-water added; whilst the juice expressed from raw beef, or one of the many meat juices now sold, may also be administered. The condition of the bowels must be attended to, and the child placed in as good surroundings as possible. Parrish's food (syr. ferri phos. co.) may be given by itself, but if the infant is thin and emaciated, cod-liver oil should be added. Deformities must, if possible, be prevented by keeping the child in the recumbent posture, and not allowing it to crawl or run about. The early stages of deformity in young children can often be corrected by daily manipulation of the affected bones; for the legs, it may suffice to keep them off their feet, as by a splint which extends from the thighs 6 inches below the soles; a certain amount of pressure can also be exercised by this appliance. Osteotomy, or even resection of portions of bone, is required in the severer cases where the deformity persists (see p. 442).

Infantile Scurvy (*Syn.*: **Barlow's Disease, Scurvy Rickets, Hæmorrhagic Rickets**).—This condition, first accurately described by Sir Thomas Barlow, presents the symptoms of scurvy in a rachitic child, and in its manifestations either one or the other set of phenomena may predominate. It is usually seen in the children of well-to-do people, usually from four to eighteen months old, and apparently arises from defective nutrition, especially from the prolonged administration of peptonized or prepared foods, or even possibly of sterilized milk. In the slighter cases there may be but little evidence of the scorbutic condition, beyond the fact that in a rickety child there is some tendency for the gums to bleed, or a little hæmaturia; but in those that are more marked the rickety signs are of little importance compared with those due to hæmorrhagic extravasations. The disease often comes on suddenly with some amount of pyrexia, rarely exceeding 102° F., but the child is evidently ill, and perhaps complains of tenderness of the limbs, which may be kept so quiet as to suggest that they are paralyzed. This is followed by the appearance of swellings of some size, due to subperiosteal extravasations, the skin over the affected parts being at first shiny and œdematous, but subsequently becoming stained by the blood-pigment. The femur and tibia are most often affected in this way, and the epiphyses may occasionally become detached, or even spontaneous fractures occur. Bleeding may also take place beneath the conjunctiva or into the orbit, leading to protrusion of the eyeball, whilst there may be blood-stained diarrhœa, hæmaturia, or epistaxis. The disease, when recognised, is readily amenable to *treatment*, but should its nature be overlooked, the child is likely to become emaciated and die. Attention to the diet is the main point to be attended to, for when fresh milk, lime-juice, or vegetables are given, the symptoms soon disappear. The affected limbs must be kept at rest, and cooling lotions applied, whilst splints are employed for separated epiphyses or fractures.

Achondroplasia is the name given to a rare and curious congenital condition, somewhat resembling rickets, in which the growth of osseous tissue on the shaft side of the epiphyses of the long bones of both arms and legs is defective, so that the limbs are short and stunted, and the stature correspondingly diminished, although the epiphyses are normal. The bones generally are not bent or curved abnormally, though there is probably some change of the neck or shaft of the femur, resulting in lordosis, which is very marked when the patient stands. The fingers taper to their tips, and are separated one from another in 'spoke-like' fashion. The bones at the base of the skull, being of cartilaginous origin, undergo premature synostosis, whilst the upper half of the skull, being derived from membrane, and therefore developing naturally, looks unusually large; the face

paralyzed or ankylosed limb. (*e*) Local pressure, as of a tumour grow
or outside the bone, or of an aneurism, may determine its existence, a
to such a degree as to result in spontaneous fracture. (*f*) It may
change, as seen in the lower jaw, cervix femoris, or cranium.

The type of atrophy varies with the cause. Sometimes it merely co
arrest of longitudinal development; at others the bones are not onl
smaller in all directions, and in leprosy may undergo almost total
If the cause is localized, and acts from without, the compact bone is
cleanly eroded; whilst if the cause is general, absorption may occur
within, the medullary canal becoming enlarged and the compact tiss
or from without, the cross-section of the bone gradually dwindling.

The possible presence of atrophy must always be kept in mind wh
with ankylosed or paralyzed limbs, since very little force may suffice
a fracture.

Mollities Ossium (*Syn.:* Osteo-malacia).

This disease is one of somewhat unusual occurrence, characteri
absorption of the osseous substance of the bones, as a result of whic
and rarefaction are produced, followed by bending or spontaneous fra

The complaint is almost limited to the female sex (only 8 per cent.
reported are in males), and usually commences during pregnancy; it i
sometimes connected with a rheumatic tendency. Any part of the sk
be affected; in females the change usually attacks the pelvis, spinal c
ribs first, and the limbs later; in men the process starts in the long bo

Pathologically, the change consists in a replacement of the med
stance by a soft fibro-cellular tissue, which is exceedingly vascula
which hæmorrhage often occurs; the resulting material looks in the
something like splenic pulp. The bony cancelli are absorbed, as also
part of the compact tissue, with the exception of a thin layer situated
periosteum; in a well-marked case the mineral salts may be diminish
one-sixth of their normal amount, but the relative proportion of phosph
to the carbonate is not changed. Part of the bone substance remains
in a decalcified state, with the corpuscles evident, but in a conditi
degeneration. Probably some acid—*e.g.*, lactic acid—is the active a
solving the earthy salts, which escape partly in the urine, partly in the
is possible that the process is connected with the absorption of so
secretion, normal or vitiated, particularly that from the ovary, an ide
by the fact that the removal of the uterine appendages has in a few c

tion to parturition, or the patient may live more or less bedridden for years, the limbs becoming useless, shortened, and perhaps contorted in a strange and abnormal fashion.

Treatment is unsatisfactory. Opiates may be administered to relieve pain, which is often very severe, and various drugs, such as alum, and phosphate or hypophosphite of lime, have been recommended. In cases not associated with parturition or pregnancy, oöphorectomy is said to have been employed with benefit. The induction of premature labour is considered by some to be beneficial, not only for the sake of obviating the necessity for such operations as Cæsarian section, but also on the chance of checking the disease.

Hypertrophy of Bone.

It is always a matter of difficulty to draw a definite line between a true hypertrophy and inflammatory or other overgrowths, and especially is this the case in connection with bones where chronic inflammation is always associated with new bone formation. Two or three conditions to which the term hypertrophy is perhaps more correctly attached may, however, be mentioned. (*a*) It is sometimes congenital; if involving a whole limb or any large portion of the body,

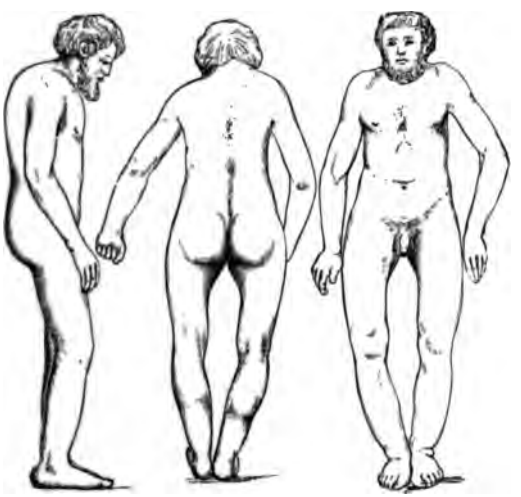


FIG. 207.—OSTEITIS DEFORMANS. (BRYANT.)

it is known as *Gigantism*; if merely affecting the fingers and toes, it is termed macrodactyly (p. 431). (*b*) It may follow inflammatory affections of bones, which are thereby left with an increased blood-supply, *e.g.*, after acute osteomyelitis, which has not destroyed the epiphyseal cartilages; in such cases the overgrowth is mainly longitudinal. (*c*) Increased growth of bones is associated with several diseases to be described immediately—viz., osteitis deformans, acromegaly, etc., and in these it is possibly due to the effect of some internal secretion.

Osteitis Deformans.

Osteitis deformans is an inflammatory disease of the osseous skeleton, first described by Sir James Paget in 1876. The onset is insidious, and the progress very slow. It is characterized by a painful overgrowth of the long bones, spine, cranium, and pelvis, which are also softened, so that those which bear the weight of the body become curved. It may commence in one bone alone, and then

usually the tibia or femur, but more often many bones are affected at the sam time. Attention may be drawn to the condition, either by the pain, which th patient at first considers to be rheumatic, or by the general enlargement an bending of the bones, or by the increased size of the head, necessitating the u of larger hats. The cranial overgrowth is eccentric in character, and the ca varium may become very thick; the facial skeleton, however, is not muc affected. The spine becomes markedly kyphotic (Fig. 207), the dorsal cur being increased, and the lumbar concavity obliterated; it is nearly rigid fro ankylosis of the vertebræ, and may be very painful. The head is carried forwar by the bend of the spine, the height is diminished, the shoulders are round, an the chest sunken towards the pelvis; the gait is slow and awkward. Th disease usually attacks middle-aged men; its progress is exceedingly slow, th patient often living to an advanced age, or dying from some intercurrent malad Some cases have terminated in multiple sarcomata of the bones. The structu of the osseous tissue is suggestive of inflammatory rather than degenerati changes. It is softer and more uniform in structure than usual, the differen between the cancellous and compact tissue being less defined; the Haversi canals are large, and arranged irregularly, whilst the bony substance is chalk looking.

Differential Diagnosis.—From *arthritis deformans*, which it resembles by th attitude and gait of the patient, it is known by the absence of articular lesion especially in the fingers, and the enlargement of the bones, notably of th cranium. From *acromegaly* it is distinguished by the absence of enlargement the hands, feet, and lower jaw.

Treatment is most unsatisfactory, no remedy at present known having an control over the disease.

Acromegaly.

Acromegaly is a rare condition the characteristics of which were first describ by Dr. Pierre Marie in 1885. It is a general affection involving mainly th osseous system, commencing usually in young adults, and, after lasting for long time, killing the patient by syncope or cerebral compression, if some inte current malady does not destroy him.

It is characterized by a very definite enlargement of the hands and feet, whi are, however, not lengthened, so that the hands have been compared to batt dores, and the fingers to sausages. The bones themselves are enlarged, and th soft structures on the palmar aspects project as pads. The nails and skin a unchanged, whilst the other segments, both of the upper and lower limbs, a usually unaffected, though sometimes considerable overgrowth in length occur in fact, many of the so-called giants who have been exhibited are typical illustr tions of acromegaly. Both the upper and lower jaws are thickened and prom nent, whilst the lower lip is enlarged and overhanging. The orbital ridg project, and the forehead is usually low; the nose and tip of the tongue are al more or less enlarged. The spine is kyphotic in the dorsal region, with a slig lumbar lordosis. The ribs and sternum project anteriorly.

The patient usually suffers from headache, lassitude, and great fatigue, wande ing pains about the body, and excessive appetite and thirst; amenorrhœa is marked symptom in women, whilst men suffer from a loss of virile power. Th urine is abundant, but of a low specific gravity. Vision is usually diminishe and optic neuritis has been observed in some cases.

Morbid Anatomy.—But little is known as to the cause or pathological chang occurring in this disease, beyond the fact that the anterior glandular half of th pituitary body is hypertrophied, and the sella turcica expanded. The changes i the bones are merely those of overgrowth.

Diagnosis.—The disease has been mistaken for *myxœdema*, but there is n much difficulty in distinguishing the two if it be remembered that, in the latt condition, the skin is not mobile over the thickened subcutaneous tissue, that th face is broad, pasty, and puffy, and that masses of gelatinous tissue are foun above the clavicle, whilst in acromegaly the face is elongated and the skin an subcutaneous tissues normal. The mental condition and speech of a patie

suffering from myxœdema are widely different from those in acromegaly; whilst in the former the thyroid body is either absent or diseased, and in the latter skeletal changes are present. From *chronic osteo-arthritis* affecting the hands, the diagnosis is easy, in that there are usually no signs of articular disease, and much less pain. From *osteitis deformans*, the distinguishing features have already been indicated.

Treatment is merely symptomatic, antipyrine being useful in relieving the headache, as also valerianate of caffeine. Possibly thyroid extract may be of some use in combating the functional phenomena, though it will not influence the skeletal changes.

Hypertrophic Osteo-arthropathy.*

It has long been known that clubbing of the terminal phalanges is associated with chronic pulmonary and cardiac disease; and it is probable that such is the earliest stage of this more generalized affection, first described by Pierre Marie. In it the

FIG. 208.—HEAD OF WOMAN WITH ACROMEGALY. SEEN FROM THE FRONT AND FROM THE SIDE.†

ends of the fingers and toes are enlarged and bulbous, with the nails curved over towards the palm or sole, but radiography has demonstrated that the change is limited to the soft tissues. There is a considerable swelling of the bones just above the wrists and ankles, extending some way along the shafts, and similar bony enlargements sometimes occur elsewhere; they are due to a diffuse osteo-periostitis. The spine is kyphotic in the upper dorsal region, but with well-marked lordosis below. It is thus seen that the changes are somewhat like those of acromegaly, from which they are distinguished by (*a*) the implication only of the terminal phalanges; (*b*) the swellings above the wrists and ankles; and (*c*) the absence of the characteristic deformities in the skull and head. These phenomena probably result from a chronic osteitis, due to toxic absorption, since the condition arises in such diseases as chronic bronchitis, bronchiectasis, and chronic empyema, where suppuration has existed for some time. It is, however, sometimes associated with lesions other than pulmonary—e.g., chronic jaundice, syphilis, and even influenza, and has even been found in otherwise apparently healthy individuals. Little can be done in the way of treatment, except to deal with the cause, if obvious.

* See Janeway, *Amer. Jour. of Med. Sci.*, October, 1903.

† Reproduced from the *Edinburgh Medical Journal*, by kind permission of Dr. G. A. Gibson.

Tumours of Bone.

The characters of the osteomata, chondromata, and fibromata of bone have been described in Chapter VIII., and various solid and cystic tumours connected with the teeth are dealt with elsewhere.

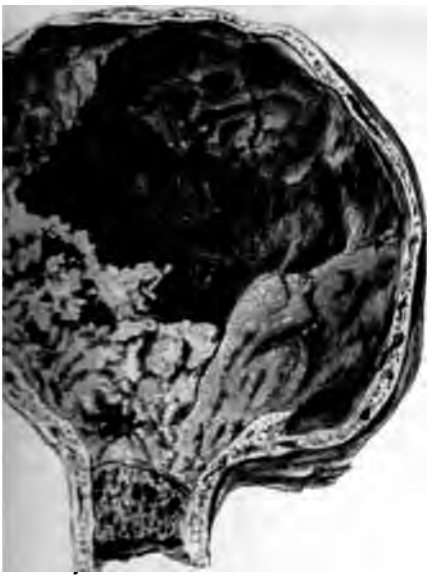
Sarcoma is the most important primary tumour of bones, and almost any form may occur. The microscopical characters have been detailed in the chapter on tumours, and we shall here only refer to their *clinical characteristics*. They may be divided into two main groups—the endosteal or central, and the periosteal.

Endosteal or Central Sarcoma (Figs. 209 and 210) of bone commences in the medullary cavity or cancellous tissue, and results in the so-called 'expansion of bone,' which consists in absorption of the bone from within, whilst at the same time new osseous tissue is being deposited from the under side of the periosteum, though in these cases only to a limited degree. The **Symptoms** at first resemble those of chronic osteo-periostitis, although in most cases of tumour there is rather less pain. The growth usually commences near the end of a long bone; it seldom encroaches on the articular cartilage, so that the joint escapes, although it may contain an excess of serous fluid; occasionally, however, the growth may extend laterally beyond the level of the cartilage, and thus invade the articular cavity. Spontaneous fracture is not an unfrequent complication, and owing to the expansion of the bony framework, 'eggshell crackling' is sometimes met with. After a while, the growth may extend beyond the osseous limits into the soft parts, and then the chances of general dissemination are considerably increased.

Two chief **varieties** of endosteal sarcoma may be described: (i.) *Myeloid* tumours (Fig. 209) are almost benign in character, never giving rise to secondary deposits, either in lymphatic glands or viscera, and their growth within the bone is limited to the region from which they originated; sometimes a layer of condensed bone forms a definite barrier to check any advance along the medullary canal. The sites of election for myeloid tumours are the lower ends of the femur and radius, and the upper ends of the tibia and humerus that is, where the growth of the limbs is greatest; they also grow within the horizontal ramus of the lower jaw and the diploe. Not uncommonly a fibro-sarcomatous epulis is myeloid in nature. They always lead to expansion of the bone; the tumour substance is soft and vascular, and they often contain cysts of hæmorrhagic origin.

(ii.) *Central round or spindle-celled sarcomata* are of a very different nature, being extremely malignant. Not unfrequently there is comparatively little expansion (Fig. 210), but the growth diffuses itself along the medullary cavity, and early infects lymphatic glands or viscera. Should the outer wall of the bone be absorbed, the growth will extend into neighbouring soft tissues. Cartilaginous and myxomatous nodules are often associated with the sarcomatous tissue.

In considering the nature of an endosteal sarcoma, it should be remembered that myeloid tumours grow more slowly than the round-



2) —Myeloid Sarcoma of Head of Tibia. King's College Hospital Museum.)

Fig. 210. —Round-celled Endosteal Sarcoma, disseminating itself in the Medullary Cavity. (King's College Hospital Museum.)

. 211 —Soft Periosteal Sarcoma f Lower End of Femur, eroding ose and leading to Spontaneous racture. (King's College lospital Museum.)

Fig. 212. —Ossifying Periosteal Sarcoma of Fibula. (King's College Hospital Museum.)

or spindle-celled, and are more likely to develop cysts, owing t hæmorrhage into their substance. In all of them a certain amou of bony skeleton may pervade the growth. Radiography may be assistance by indicating whether the growth is localized or diffus through the medullary cavity.

The **Periosteal Sarcomata** are round- or spindle-celled in natur They often grow very rapidly, without giving rise to much pai unless causing erosion of the bone. They usually start on one sid of the bone, but later on may surround its whole circumferenc They spread rapidly along its exterior, and are highly malignant i nature, giving rise to secondary growths in the neighbouring lymphati glands or in the viscera. They frequently become ossified (Fig. 212) with or without the development of cartilage, and in such cases th subjacent bone becomes sclerosed and thick. The bony skeleton o such a growth is very characteristic, consisting of fine spiculated trabeculæ, radiating more or less regularly from the surface, and looking in the dried state somewhat like asbestos. When a periosteal sarcoma does not become ossified, the growth usually erodes the underlying bone (Fig. 211), and may lead to spontaneous fracture; the tumour in such cases is softer and more elastic than in the former variety. All osseous sarcomata are exceedingly vascular, and may even pulsate, whilst the superficial veins are obviously dilated beneath the stretched integument, giving rise to a blue network.

The **Diagnosis** of osteo-sarcoma in the early stages is often a matter of the greatest difficulty. The endosteal form may easily be mistaken for chronic osteo-periostitis, medullary gumma, or a deep abscess of the bone, and can sometimes only be distinguished from them by an exploratory incision, which should always be undertaken in doubtful cases prior to radical operations, such as amputation. In the later stages, the presence of 'eggshell crackling' or cystic change will help to make evident the nature of the disease. The periosteal form may at first be looked upon as a periosteal node, or a deeply-placed abscess. The rounded and definite edge of the growth, its irregular consistency, and the history of the case, will assist in the determination of its nature; but in the early stages an exploratory operation is not unfrequently necessary. For the diagnosis of a pulsating sarcoma from an aneurism, see p. 307. When either form involves the articular end of a bone, especially the lower end of the femur, it may simulate tuberculous disease of the adjacent bone. It will, however, be noted that the centre of the swelling corresponds to a point well above or below the joint, that a certain amount of movement is possible and even painless, whilst the starting pains at night characteristic of joint mischief are absent. The age of the patient, and the presence or not of cachexy, are also important features which have to be taken into consideration. Skiagraphy serves in some cases as an important diagnostic adjuvant.

The **Treatment** of osteo-sarcoma must always be of a radical nature, and, remembering the highly malignant character of many of these growths, we would strongly urge the importance of an early explora-

n doubtful cases; if undertaken with antiseptic pre-
:m can ensue, and a definite diagnosis is thereby
ɜ case is left until increased growth reveals the true
it is more than likely that, except in the myeloid
ɔe too late for successful operative interference. In
e disease except the myeloid, the affected limb should
above the tumour. Thus, if growing from the lower
disarticulation at the knee-joint should be performed;
end of the tibia, amputation through the middle or
ıe thigh; if from the lower end of the femur, ampu-
the upper third of the bone, if not at the hip-joint.
the head of the humerus, disarticulation through the
ay suffice, but it is often wiser to remove the scapula
of the clavicle as well (interscapulo-thoracic amputa-
ılts of the latter proceeding, as regards final cure,
more satisfactory than those of the former. When
s have been invaded, it is desirable, though not
ɔle, to include the whole extent of them in the scope

ımata being practically non-malignant, except locally,
in a much more conservative manner, amputation
tissue just above the growth being all that is neces-
sable that the medulla at the point of section of the
ɜxamined microscopically before the wound is closed,
that it has not been invaded. When affecting the
radius or upper end of the humerus, and not in too
ge, an attempt may be made to save the limb by
ased portion of bone. In the wrist a portion of the
ay, as well as the growth in the radius; by this plan
nce of the hand being drawn up and abducted, and
e likely to become useful. A leather gauntlet to
t subsequently will almost certainly be required.
of the lower jaw, if myeloid in nature, may be treated
ɜ opening in the bone, scraping the diseased tissue
ɔing out the cavity with pure carbolic acid. The con-
v may thus be maintained, even if the teeth are lost.
coma of bone is by no means uncommon. It is
ıl in character, and, except in the most unusual
will not demand treatment, owing to the general
system. Possibly where it has led to spontaneous
ɜre is much pain owing to the difficulty of fixation,
fiable to remove the limb.
ɔone is always secondary in nature, although it may
direct extension in a primary growth. It may
l to spontaneous fracture, but the bone may con-
ıtisfactorily.
led **Thyroid Cancer** of bone, see Chapter XXXI.
ours of Bone, or Osteo-aneurism.—Apart from pulsat-
ɔ other conditions are met with, the nature of which

cannot be considered as yet settled, in which distinct pulsa noticeable.

In the first of these the medullary cavity is occupied malignant vascular tissue, practically identical with wh already described as an *aneurism by anasto mosis*. A large small arterioles open into spaces without the interventi laries, so that an erectile tissue similar in nature to the co nosum penis results. Such tumours are situated most fr the cranial bones, and may be multiple, the medullary t in consequence atrophied, and the compact tissue thin 'eggshell crackling' may be obtained.

The second form is found most commonly in the uppe tibia, or some such cancellous mass. It consists of a ho filled with blood. Several distinct arterial twigs may o and the overlying bone is thinned and absorbed. It is p the majority of such cases are in reality due to the breaki sarcomata of extreme tenuity.

The **Treatment** of these cases necessarily varies with th found after a preliminary incision into its substance, wh always be made after rendering the limb bloodless. Wh probable that the condition is not associated with malign or is merely due to a myeloid tumour, the cavity sho scraped, swabbed out with pure carbolic acid, and then fi with gauze, so as to obtain healing by granulation from In other cases amputation is the only treatment.

Hydatid Disease of Bone.—The cancellous tissue of l sionally becomes the site of hydatid development, any p the medullary cavity or of the ends being involved. becomes expanded, with all the symptoms of an endost Considerable deformity may occur, and when the compa becomestufficiently absorbed, spontaneous fracture may this affection there is no limiting wall, the small daughter diffused through the affected area. A diagnosis is little made (at any rate, in this country, where hydatid disease prior to an exploratory incision. **Treatment.**—If all the removed without interfering with the integrity of the shaft, with good subsequent utility of the limb, should follow. V ever, the disease has encroached widely on the bony tiss spontaneous fracture has occurred or not, amputation h only prospect of cure.

30 P.T.

CHAPTER XXI.

INJURIES OF JOINTS—DISLOCATIONS.

ains and Strains result from sudden violence applied to a joint, ther directly or indirectly, as in the football field or in many lorious occupations. They consist in a tearing or stretching of e synovial membrane, partially detached portions of which may be ched inwards, or of ligaments, which in bad cases may be torn m their attachments to the bones. The accident itself is ociated with severe pain, and is immediately followed by more or s hæmorrhage into the surrounding tissues, or into the articular ity. Inflammatory effusion follows, and unless wisely treated, sistent weakness and pain in the joint, either from the formation adhesions, or from imperfect repair of the ligaments, may result. neglected sprain may originate tuberculous disease in those who e so predisposed, whilst osteo-arthritis is a by no means un-mmon sequela. If the patient is in a bad state of health at the e of the injury, an attack of acute infective arthritis may be termined. **Treatment.**—The joint should be firmly supported by et bandage as soon after the accident as possible, in order to nit the amount of effusion. The part is raised and kept quiet, and e bandage dabbed over with evaporating lotion from time to time. the slighter cases the patient may be allowed to use the limb in a w days, the part being supported by strapping or an elastic ndage; but in severe sprains it may be necessary to keep the part solutely at rest for a much longer period, before the pain and derness disappear. Friction with stimulating liniments, douching e joint alternately with hot and cold water, massage, passive and tive movements, and finally exercises against resistance, are useful restoring the limb to full functional activity. Splints are only quired when the ligaments are badly torn.

Penetrating Wounds of Joints are often accompanied by an escape synovia, which is recognised as a glairy, oily fluid, floating haps on the surface of the blood; if, however, the aperture is all, this may not occur. It is always followed by a certain ount of reaction, the character of which depends on whether or the joint is infected. If no infection has taken place, and the t is kept quiet, a simple synovitis ensues, and soon passes off, if,

however, micro-organisms have entered, acute arthritis probably supervenes, leading to destruction and disintegration of the joint (For symptoms and treatment, see p. 652). A penetrating wound even if untreated, does not necessarily become septic; thus, if the lesion is produced by a small clean instrument, and especially if this is inserted in a slanting direction, so that the wound is valvular, or if the incision is a large one, allowing free vent to all discharges, recovery without septic inflammation is possible.

Treatment.—If the wound is small, and the surgeon has reason to believe that the instrument inflicting it was aseptic, the external skin should be thoroughly purified, and an antiseptic dressing applied. A careful watch must be kept upon the condition of the joint, and upon the temperature of the patient; as soon as any signs of acute arthritis manifest themselves, free incisions are made into the joint so as to relieve tension and allow the cavity to be irrigated. If however, the wound was inflicted by a dirty instrument, and there is but little doubt that the joint has been penetrated, it is most important to make certain of this fact. For this purpose the wound should be enlarged so that its depths may be purified, and then carefully examined. If it is found that the cavity has been opened the aperture should be increased in size so as to allow it to be washed out and a drainage-tube inserted; if acute arthritis supervenes, it must be treated in the usual way.

Dislocations.

Although the term 'dislocation' is most commonly applied to a forcible displacement of one of the bones entering into an articulation, as the result of an injury, it must not be forgotten that congenital and pathological displacements also exist.

Congenital Dislocation.—This term is applied generally to any defect of a joint present at birth, but is really a misnomer, since the condition is almost always due to an error of development, as a result of which a normal location of the bony constituents has never been present, and hence a *dis*location cannot have taken place. The hip joint is most frequently affected; but similar malformations have occurred in the shoulder, wrist, and jaw, whilst the patella may be congenitally absent or displaced.

Congenital Dislocation of the Hip is by no means rare, although its causation is still quite uncertain; probably it is due in some cases to malposition of the fœtus in the uterus or to some irregularity in the shape of the uterine wall, *e.g.*, such as results from the presence of fibroids. The malformation is frequently bilateral, more commonly unilateral; it occurs rather more frequently in girls than in boys (53 : 47 per cent.). It often passes unnoticed until the child begins to walk, and then the characteristic signs become evident. The limb is shortened and flexed on the pelvis, owing to the traction of the ilio-psoas muscle, necessitating a considerable amount of lordosis to maintain the body in a vertical position (Fig. 215), whilst scoliosis

is well marked in one-sided cases. Since the head of the femur is displaced from the middle line, a gap is usually noticed between the thighs close to the perineum. Considerable adduction of the lower end of the femur (Figs. 213 and 214) may result from muscular contraction (adductors), and in bilateral cases a scissor-leg deformity may ensue. The patient's gait is of a curious waddling character, which becomes very marked if one side alone is affected. Since the head of the bone is only maintained in position by its ligamentous and muscular attachments, it can often be drawn down at first, and

FIG. 213.

FIG. 214.

FIGS. 213 AND 214.—CONGENITAL DISLOCATION OF BOTH HIPS IN A GIRL OF FIFTEEN YEARS, SEEN FROM THE FRONT AND BACK. (FROM PHOTOGRAPHS KINDLY LENT BY MR. J. JACKSON CLARKE.)

the leg thus lengthened to the extent of an inch or two; moreover, it is often easy to reduce the displacement and put the head of the bone in the acetabulum in children that have not walked much. It is sometimes necessary to invert, sometimes to evert, the limb, as well as make traction, in order to accomplish this, the head of the bone not being always in the same place. At a subsequent date strains to the limb are almost entirely borne by the ligamentous tissues, and hence attacks of synovitis are common.

The **Pathological Anatomy** varies considerably according to whether or not the child has walked. At *birth* the head and neck are sometimes nearly normal in shape, and located near the acetabulum; generally, however, the head is rather small and perhaps flattened at the spot where it rests against the innominate bone, and the neck is short and stunted. The ligamentum teres is long, thin, and band-like. The acetabulum is smaller and more shallow than usual; it can often receive the head of the bone, though it cannot retain it: this is stated by Lockwood to be due to the absence of the cartilaginous rim, but this explanation is certainly not true in all cases. The capsule is large and roomy. *After the child has walked*, sundry modifications make themselves evident. The head of the bone becomes more and more displaced, so that it may finally lie well above the acetabulum on the dorsum ilii (Plate XXVII.). The capsule becomes stretched over the displaced head, and much thicker than usual; the ligamentum teres is stretched. The head of the bone is considerably altered and often much deformed; the acetabulum becomes triangular in shape, owing chiefly to want of growth of the iliac portion; whilst the muscles are necessarily modified as to their length. A new, but very imperfect, acetabulum forms on that portion of the dorsum ilii where the head of the bone usually rests.

FIG. 215.—SIDE VIEW OF SAME PATIENT TO SHOW THE EXTREME LORDOSIS.

Treatment.—Should a diagnosis be made before the child has commenced to walk, there is no reason why treatment should not be instituted at once. The head of the bone can usually be placed in its socket, and is kept there by fixing the limb in a position of abduction, whilst inward pressure is made over the trochanter with a screw apparatus. Schede has by this means converted the unstable articulation into a stable one. Such treatment will last from six to twelve months. Others have effected the same result by prolonged traction.

At a later age (up to five or six years) Lorenz's *bloodless method of treatment* may be employed with good hopes of a successful issue in unilateral cases. (1) The head of the bone is first drawn down to the level of the acetabulum. Some surgeons recommend this to be effected by gradual extension; others do it at one sitting under an anæsthetic. The adductor muscles are the chief hindrance, and will require a good deal of kneading, or even possibly section with a tenotome. (2) The head of the bone is to be replaced in the

PLATE XXVII.

Double Congenital Dislocation of the Hip

acetabulum, and as this cavity is small and chink-like, and sometimes covered in by the front of the capsule, a good deal of difficulty may be here experienced. The limb is fully flexed and then forcibly abducted, extended and everted, no undue violence being permissible, or the bone may be fractured. The head of the bone can sometimes be felt to slip into the acetabulum, and the manœuvre should be repeated several times, as it were, grinding the head of the femur into the acetabulum. (3) The limb is then put up in plaster of Paris from the pelvis to the knee in a position of abduction and slight eversion, and with the leg flexed. It is maintained in this position for ten or twelve weeks, and it is well to ascertain by skiagraphy that the bone has not slipped. At the end of that period it will probably be found that a less degree of abduction will suffice in order to keep the bone in place, and a fresh case of plaster is applied with the limb in this new position, the extension and outward rotation being maintained. As soon as possible the child is encouraged to walk on the limb in this position of abduction, so as to force the head of the bone still deeper into the acetabulum; crutches are required at first, but he will soon do without them. The plaster casing is usually needed for six months.

In older children (from five to ten years) *operative treatment* can be undertaken with some prospect of success. Hoffa and Lorenz have been the great exponents of this proceeding, though for children under five years they both admit the value of the bloodless method. Their operations consist in opening the joint from the back and front respectively, shaping up the head of the bone, enlarging the acetabulum so that the head can be replaced in it, and dividing any tense structures which prevent reduction. The limb is subsequently immobilized in a position of eversion and abduction, but for as short a time as possible. Even if ankylosis results, the patient's gait is considerably improved.

Pathological Dislocations are produced as the result of some intra-articular affection, *e.g.*, tuberculous disease, osteo-arthritis, Charcot's disease, etc. It is unnecessary to describe them here.

Traumatic Dislocations.

Causes.—These are divided into the predisposing and exciting. Under the former head may be included some anatomical peculiarity of the joint, such as the shallow socket of the glenoid cavity, or some weakness of the muscles or ligaments which control the movements of the articulation. Dislocations are rare in children, since any violence directed to a joint or its neighbourhood is more likely to lead to an epiphyseal separation. Moreover, in old people the bones become brittle, and thus fractures, rather than dislocations, are produced; hence the latter lesions are almost limited to adults, and, owing to their greater exposure to injury, occur in men rather than in women.

The Exciting Causes are the application of external violence and

muscular force, acting alone or in combination. The former may be direct, but is more commonly indirect, the force being applied at a distance from the joint. Muscular action by itself can only produce dislocation in certain joints, which by their peculiar conformation are predisposed to it; the head of the humerus, the patella and condyle of the jaw, are the bones most often affected in this way. If, however, the ligaments of a joint have been stretched by previous disease or displacement, recurrent dislocations, the result of muscular action, are not unusual.

The term *complete dislocation*, or *luxation*, is applied to that condition in which the articular surfaces of the bones are completely separated from one another. An *incomplete dislocation*, or *subluxation*, is one in which the surfaces are only partially separated.

A *compound dislocation* is one in which the skin has been ruptured and a communication established with the external air. A *complicated dislocation* is one in which there has been some associated injury of vessels, nerves, or viscera. The term *fracture-dislocation* is one applied to a condition in which a dislocation is complicated by fracture of one or both bones involved.

The **Signs** of a dislocation are as follows: (1) The evidences of a local trauma, *e.g.*, pain, bruising, and swelling of the soft tissues due to their laceration and the effusion of blood into them: the amount of this varies in different cases; (2) deformity of the limb due to the articular end of the displaced bone being in some abnormal position, where it can often be felt and sometimes seen; and (3) restricted mobility of the affected joint, and hence impairment of function of the limb. The degree to which this latter phenomenon obtains is necessarily variable, but, as a rule, it is very marked; if, however, fracture is also present, passive movements may be possible, though associated with pain and crepitus.

The **Effects** produced by a dislocation extend to all the structures entering into and surrounding the site of injury. The ligaments are partially or completely torn; the bony surfaces are not unfrequently fractured, especially in closely-fitting hinge joints, such as the elbow and ankle; the cartilages may be bruised, or portions of them detached, and neighbouring muscles and tendons lacerated and displaced; adjacent vessels and nerves are often contused or compressed. Considerable effusion of blood is always present, infiltrating the whole area involved.

The character of the injury explains the difficulties that are met with in its reduction. These arise from two main causes: (*a*) The anatomical structure of the joint and its ligaments, resulting in the hitching of bony prominences against one another, whilst the head of the bone does not always lie opposite the hole in the capsule through which it originally passed. In a few cases the end of the bone may be grasped by neighbouring ligaments and muscles in such a way as to render its replacement a matter of the greatest difficulty. (*b*) Muscular contraction also constitutes an obstacle, which, though formerly difficult to counteract, is now readily overcome by the use

næsthetics. Not only does the patient maintain the limb in a lition of rest by a voluntary tonic contraction, but it becomes l by the involuntary passive tension of the displaced muscles. eover, clonic spasms may arise from the direct or reflex irritation rves, and these the patient is quite incapable of controlling.

hen once reduced, Nature soon restores the part, so that in many s no permanent lesion remains, although in some the rent in the ule does not heal firmly, leaving the joint weak and liable to a rrence of the displacement, while intra-articular adhesions, or the tricial contraction of the injured ligaments and muscles, may e some loss of mobility.

A B

216.—OLD-STANDING SUBCORACOID DISLOCATION OF THE SHOULDER, SHOWING ATROPHY OF TRUE GLENOID CAVITY, TOGETHER WITH FORMATION OF NEW JOINT AND ALTERATION IN SHAPE OF HEAD OF BONE. A, VIEW FROM THE FRONT; B, FROM THE OUTER SIDE. (FROM COLLEGE OF SURGEONS' MUSEUM.)

f a dislocation is *allowed to remain unreduced*, the true articular cavity omes shallow and partly filled up by a transformation of its cartilage) fibrous tissue, whilst the displaced head of the bone becomes erent to the structures amongst which it lies; as the result of a tic inflammation, either dense fibrous adhesions are formed, or a false joint (*pseudarthrosis*). The articular cartilage is eroded, and exposed bone eburnated and sclerosed, whilst, owing to chronic ostitis, the end of the shaft may be considerably deformed. The ion of bone upon which the displaced head rests undergoes changes, ly atrophic (from pressure), partly hypertrophic (as a result of

chronic periostitis), whereby a new socket is produced (I
Neighbouring muscles are secondarily shortened, and acco
themselves to the abnormal position of the limb, and tendo
have been torn gain fresh attachments. These changes n
interfere more or less seriously with the power of the limb
movements of the joint.

Treatment.—The treatment of dislocations consists in the
of the displaced bone with as little delay as possible. Ther
chief methods of gaining this end, viz., manipulation and e

Manipulation is always the best means to employ where pr
less injury being sustained by the surrounding tissues. It
in moving the limb in such directions as shall cause the displ
to retrace the course that it has already taken, through th
the capsule to its normal position. The shoulder and hip j
more amenable to this method of treatment than hinge joint
thesia will be required in difficult cases. The special mani
needed in any particular instance are detailed under the vario

Extension is employed to overcome muscular and other
resistance, so as to draw the bone back into its original posi
order to make this effectual, the parts above the dislocation are
by some *counter-extending* force applied either by the han
assistant, or by a belt or towel, or by the knee or foot of the
Extension may be made by the hands, or a firmer grip may
tained, and greater force used, by applying a bandage or a ja
to the limb by means of a clove-hitch. In a few cases, the fo
be exerted through some form of multiplying pulley, fixed at
to a hook or staple, and at the other end to the loop of a
bandage attached to the limb. When any such contrivanc
ployed, precautions must be taken to prevent the soft tissu
being injured. A useful plan consists in applying a damp
at the point from which traction is to be made, and over thi
skein of worsted in the form of a clove-hitch, the loop being
to the hook of the pulley. The extension must be made contin
no jolting or jerking action is allowable, or considerable misc
ensue. Since the introduction of anæsthetics, however, pull
been very rarely required, except in dealing with old-standin

Reduction, however produced, is usually accompanied by a
and distinct snap or suction sound, due to the contraction of
unless the patient is deeply under an anæsthetic, and the
are absolutely relaxed. The limb is subsequently kept at
some days, to allow the rent in the capsule to heal. Cooling
are applied to reduce the swelling, and at the end of ten d
fortnight passive movements commence, together with fric
massage of the soft parts.

The treatment of unreduced dislocations is often a matter of c
able difficulty. Attempts to reduce them may be undertake
two or three months, but no undue violence is permissible, o
the fact that adhesions to neighbouring parts may the
ruptured, and the main vessels or nerves endangered. The

xeen sometimes recommended, but so many accidents ported, varying in severity from laceration of the skin lsion of the limb, that it is better to discontinue such t has failed on its first application.

ıt of mobility possible in an unreduced dislocation varies n different cases, and the character of the treatment is ned by this. If movement is tolerably free, and not ıainful, massage and manipulation may be undertaken, ıeful limb result. Where, however, movement is both mited, operative treatment should be undertaken; sub- :tion of muscles and tendons has been practised, but ı success, and the risk, owing to the fact that the peri- ıctures are displaced and distorted, is so great as to procedure unadvisable. Two chief methods of opera- t are applicable: (i.) Reduction by an *open operation*. the bone is cut down on, and freed from its adhesions g structures, the capsule of the joint being also opened y cleared; reduction may then be possible by means of or extension. A few cases of successful treatment of lislocations of the shoulder by this means have been t, as a rule, the gain derived thereby is not commensu- risks and difficulties of the operation, especially if a interval has elapsed since the accident. (ii.) *Excision* ed head of the bone will give the best result in most e elbow-joint it is often the only practicable treatment, houlder and hip it is usually better than attempting n.

Dislocations are almost always serious lesions, for not only erated, and the joint exposed to the risk of septic con- ıut adjacent vessels and nerves are liable to injury. nt treatment is adopted, suppurative arthritis ensues, isorganization of the articulation, with subsequent in the case of larger joints, possibly to death from eptic poisoning. The *treatment* consists in the routine atment of the wound, together with reduction of the If necessary, the opening in the skin must be enlarged, ow of the replacement of the bone, and should the latter nuch bruised or injured, it may be advisable to resect , however, vessels and nerves are also injured, or if the or debilitated, amputation may be required.

Special Dislocations.

of the Lower Jaw forwards is not a very common usually results either from muscular action, or from a :hin when the mouth is widely open, as in gaping, laugh- pting to take a large bite. It has also been produced ıy a violent strain during tooth-drawing, or from digging h an elevator. In some persons the accident happens

with the greatest ease, and constantly recurs, owing prob
laxity of the capsule or insufficient development of the em
articularis.

The *mechanism* of the dislocation is as follows: When the
is opened, the condyle of the jaw slips forwards on to the em
articularis, and it requires very little force to displace it still f
into the zygomatic fossa (Fig. 217). The inter-articular ca
sometimes follows the co
and the attachment of t
ternal pterygoid muscle
structure and to the bo
plains the occurrence of
cation from muscular act

Fig. 217.—Dislocation of Jaw.

The displacement m
unilateral or bilateral, mo
quently the latter. The
remains widely open, the
and the jaws being sep
by an interval of about an
The lower jaw projects u
and is fixed, saliva dri
over the lip; speech and
tition are impaired, the
nunciation of the labia
sonants being especially di
A hollow can be detected immediately in front of the tragus,
the condyle is normally lodged, and in front of this hollow th
dyle can be felt, being recognised by the slight amount of
movement still possible. A finger in the mouth may det
coronoid process in an abnormal position beneath the zygoma.

When the dislocation is unilateral, the symptoms are mu
marked. Some amount of movement of the jaw still remains,
the chin is displaced towards the sound side.

Treatment.—Reduction is usually easy. All that is needed
depress the condyle below the level of the eminentia articularis
the masseter, temporal, and internal pterygoid muscles speedil
it back into the glenoid cavity. The patient is seated in a
the surgeon standing in front protects his thumbs with thick m
and introduces them into the mouth, pressing upon the lower
teeth. Pressure is continued in a downward and backward di
until the condyle is free, and then the chin is raised by the fing
either side. The jaw is kept at rest for a few days by mean
four-tailed bandage.

A few cases are on record of displacement of the condyle
jaw *backwards*, associated with fracture of the tympanic pla
tearing or separation of the cartilage of the auricle, leading to bl
from the ear. Displacement *upwards* into the cranial cavity t
the roof of the glenoid fossa has also been described, the pa
one case dying of meningitis.

ion of the Sternal End of the Clavicle.—In spite of the weakness of this joint and the great strains to which it is dislocation is uncommon, owing to the strength of the surrounding it, particularly of the rhomboid, the clavicle re easily broken than displaced. The **cause** of such dis- s is violence directed to the acromial end of the clavicle. e acts from in front, the bone may be thrown forwards; if re, downwards and inwards, the upward dislocation may the shoulder is driven forwards and inwards, the head of nay pass backwards. Three varieties are described, accord- ether the head of the bone travels *forwards*, *backwards*, or

orward dislocation the end of the bone lies on the anterior the manubrium, where it can be easily detected; all the of the joint are torn, except, perhaps, the interclavicular. of the shoulder is approximated to the middle line. *Treat-* duction is effected by placing the knee against the spine :he scapulæ, and drawing the shoulders backwards, the the affected side being kept in front of the mid-axillary line. acement is very likely to recur, and to prevent this a pad er the end of the bone by a figure-of-8 bandage, whilst the :he shoulder is pushed outwards by placing a pad in the l binding the arm to the side. It is advisable to keep the bed for a few days, so as to give the ligaments a better re-uniting, but some amount of forward displacement is r to persist. No bad result follows, even should the dis- main unreduced.

kward dislocation is not often met with. The head of the behind the upper part of the sternum, close to the origin of -hyoid and sterno-thyroid muscles. All the ligaments are including the rhomboid. A depression is felt in the usual f the head of the bone, which may be sometimes detected ily in the superior mediastinum. The shoulder is thrown and situated nearer the middle line of the body than usual, movements of the head and neck are painful and limited. of the bone upon the trachea, œsophagus, and vessels of gives rise to difficulty in breathing and swallowing, whilst quent congestion of the head may even cause semi coma. i by extension of the shoulders backwards is usually accom- thout much trouble. In cases of difficulty, a firm pad can in the axilla, and the shoulder levered outwards by using it um, the elbow being pressed to the side. It is retained in y keeping the shoulders well extended by the use of two iefs, as suggested in the treatment of fractured clavicle. If tion cannot be reduced, and serious symptoms of pressure head of the bone should be excised.

ward dislocation is one of extreme rarity. The head of the t in front of the trachea, in which situation it may compress lpipe and œsophagus, especially when the patient sits up or

leans forwards. To effect reduction, a pad is placed in the axilla, a the arm pressed inwards over it; the elbow is subsequently bandag to the side and well elevated. A pad is at the same time kept o the end of the bone, but it is very probable that some amount displacement will persist.

Dislocation at the Acromio-clavicular Joint consists in the acromio being forced either above or below the outer end of the clavicle, mor commonly the latter. The displacement is easily recognised by the abnormal prominence of one or other of the bones (Fig. 218). It usually results from violence directed to the scapula. No difficulty is experienced in reduction, but the displacement is very liable to recur, especially in the more common form. The elbow is then flexed to a right angle, and pads of lint or small towels placed over the acromion and beneath the elbow; a bandage or strap is then applied over the shoulder and under the elbow, and suffices to maintain the bone in position. The strap is kept from slipping by passing a bandage under it round the opposite side of the chest. Should the displacement persist, and give rise to pain or impair the movements of the arm, the bones may be wired together after removing the cartilaginous surfaces.

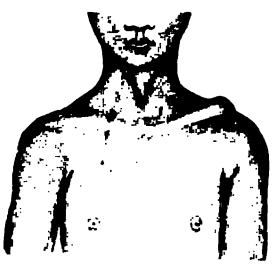


FIG. 218.—DISLOCATION DOWNWARDS OF ACROMION FROM THE END OF THE CLAVICLE. (TILLMANNS.)

A condition is sometimes met with, described as a **Dislocation of the Lower Angle of the Scapula**, or, better, **Winged Scapula**. It is characterized by projection backwards of that part of the bone when the arms are thrust forwards; and is due rather to paralysis of the serratus magnus and rhomboids than to slipping of the fibres of the latissimus dorsi from the lower angle, as was formerly supposed. The paralysis results from chronic neuritis, traumatic or otherwise, of the roots of the fifth and sixth cervical nerves, which may be found tender on pressure.

The **Treatment** consists in the use of massage and of the faradic current, whilst, if persistent, a properly-applied apparatus may correct the deformity.

Dislocation of the Shoulder occurs almost as frequently as all the other dislocations of the body put together. The shallowness of the glenoid cavity, the size of the head of the humerus, the laxity of the capsule, the extent and force of the movements possible, and the exposed position of the shoulder, explain the great frequency of the accident. It usually results from falls upon the hand or elbow, the arm at the time of the accident being widely outstretched, so as to enable the individual, if possible, to save himself. The weak lower and inner part of the capsule receives the chief portion of the shock and yields, the head of the bone being primarily displaced downwards into the axilla (subglenoid variety), and then, according to the direc-

tion of the force, or the character of the subsequent manipulations, the head travels either forwards (subcoracoid or subclavicular dislocation) or backwards (subspinous). Falls on the elbow or shoulder may, however, cause a direct forward or backward displacement.

The **Signs** of a dislocation of the shoulder are sufficiently obvious, and certain characteristic features are present in almost all varieties. (1) The shoulder looks flattened, owing to displacement of the head inwards (Figs. 161, B and 221), and as a result of this the acromion process is unduly prominent, and a hollow, felt below it, occupied by the tense deltoid. (2) The head of the bone lies in some abnormal position, and the glenoid cavity is empty. (3) The elbow is displaced away from the side, and it is impossible to make it touch the chest wall at the same time that the hand is placed on the opposite shoulder (Dugas' test); this does not always obtain in the subcoracoid type.

FIG. 219.—SUBGLENOID DISLOCATION OF SHOULDER. (TILLMANNS.)

FIG. 220.—SUBCORACOID DISLOCATION OF SHOULDER. (TILLMANNS.)

(4) The vertical measurement round the axilla is increased in all the varieties (Callaway's test); whilst inspection reveals a lowering of the anterior or posterior axillary fold (Bryant's test). (5) A ruler or straight-edge can be made to touch both the acromion process and the outer condyle of the elbow in most cases of dislocation (Hamilton's ruler test); this is impossible when the head of the bone is in its normal position, but can also occur in fractures of the anatomical neck. At the same time, the usual signs of a dislocation, viz., rigidity and local bruising, are also present.

Subglenoid Dislocation (Fig. 219) is always the primary condition when the accident is due to a fall upon the outstretched arm, but is not commonly seen, since the head of the bone subsequently slips up under the coracoid, as before stated. The head of the bone passes down into the axilla, resting against the outer border of the scapula below the glenoid cavity, between the subscapularis above and the teres minor below, with the long head of the triceps behind. The capsular ligament and muscles passing to the tuberosities are torn, whilst the axillary vessels and nerves may be seriously compressed, leading to

numbness of the fingers. The head of the bone is felt in the a and the anterior axillary fold is much lowered; the elbow is dis away from the side and slightly backwards; the arm is length perhaps to the extent of 1 inch, whilst the fore-arm is usually fl

A few cases have been recorded in which the arm was abd and displaced vertically upwards, although the head of the was in the usual position of a subglenoid dislocation. This v is known as the *luxatio erecta*.

Subcoracoid Dislocation (Figs. 220 and 221) is, without doub most common form. The head of the bone lies under the cor process on the anterior part of the neck of the scapula, immed in front of the glenoid cavity, the anatomical neck impingi

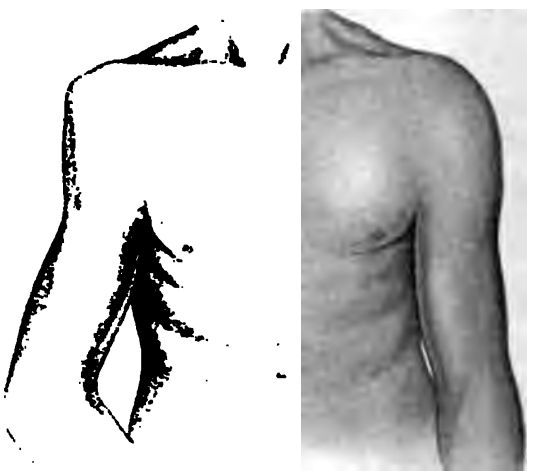


FIG. 221. SUBCORACOID DISLOCATION OF THE RIGHT SHOULDER.

its anterior border. In this position it is above the tendon o subscapularis, which is either torn or stretched over the nec a tense band, and may considerably impede reduction. Two f of this displacement are described by Malgaigne, accordin whether the muscles attached to the great tuberosity are in resulting in marked external rotation of the limb (subcor variety), or whether they are lacerated, or even the great tube itself pulled off, the humerus being then rotated inwards (i coracoid variety). In both types the elbow is displaced backw and outwards, and the head of the bone can be usually felt case, especially on rotation of the arm, under the outer third o clavicle, except in stout people or where the muscles are gr developed. Comparatively little alteration in the length of the is produced.

The **Subclavicular** variety is very uncommon, and merely an exaggeration of the subcoracoid. The head of the humerus passes further inwards, and lies deeply under the pectoralis major, on the second and third ribs. The capsule and surrounding muscles are much lacerated, or perhaps the great tuberosity torn off; the elbow is markedly separated from the side and directed a little backwards, whilst distinct shortening is present.

The **Subspinous Dislocation** (Fig. 222) is unusual. The head of the bone lies in the infraspinous fossa, immediately behind the glenoid cavity, between the infraspinatus and teres minor muscles, the subscapularis being generally torn. Malgaigne states that the head of the humerus is most commonly found resting on the posterior edge of the glenoid cavity immediately below the acromion process (subacromial variety). The elbow is displaced considerably forwards, but can be made to touch the chest wall; the arm is rotated inwards, so that the hand is thrown across the front of the body. There is usually a marked hollow beneath the coracoid process, whilst a distinct prominence is caused by the head of the bone in its false position. The length of the limb is frequently unaffected, or if any change is present, the arm is slightly lengthened.

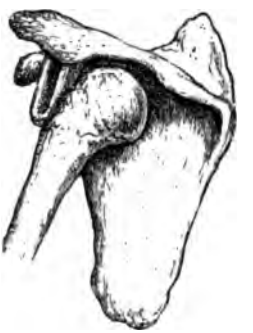


FIG. 222.—SUBSPINOUS DISLOCATION OF SHOULDER. (TILLMANNS.)

Three or four cases have been described of what is known as a **Supracoracoid Dislocation.** The head of the bone is here displaced upwards, and either the coracoid or acromion process is broken, more commonly the former. Replacement with crepitus is easily obtained, but the dislocation is liable to recur.

The **Treatment of Dislocation of the Shoulder** consists in reduction by manipulation or extension.

1. For *reduction by manipulation* an anæsthetic is advisable, but not absolutely essential, and preferably chloroform, although when the patient is in a bad state for the administration—*i.e.*, with his stomach full of food—ether may be preferable. It is only right to draw attention to the fact that a large number of fatal cases of chloroform administration have been reported as occurring in the treatment of shoulder dislocations; this is due mainly to two causes, viz., the deep anæsthesia required, and the want of preparation of the patient. The greatest care must therefore be exercised in giving the anæsthetic.

Many different methods of manipulation have been suggested, of which the following are the more important. Not unfrequently, when the muscles are relaxed, any slight rotary movement suffices to 'put the bone in.'

Kocher's Method for Subcoracoid Dislocations.—The surgeon standing in front of his patient, who is seated or reclining, and supported by

an assistant, grasps the elbow after flexion of the fore-arm, and presses it to the side. The arm is now rotated firmly and steadily outwards until the fore-arm is at right angles to the body, when often distinct resistance will be felt. This causes the head of the humerus to roll out beneath the acromion, and is often sufficient to effect reduction; but if the limb is still displaced, the arm should be drawn forwards to the median line and elevated almost to a right angle with the trunk, with the hand still abducted and everted, whilst finally the arm is rotated inwards so as to carry the hand towards the opposite shoulder, and the elbow lowered. The value of this plan, according to Kocher, turns on the fact that the posterior part of the capsule and the scapular tendons inserted therein are usually untorn and stretched tightly across the glenoid fossa. Rotation outwards relaxes this structure and removes it from the fossa, whilst the rent in the capsule gapes; but owing to the fact that the upper and lower margins of the opening are still tight, the head of the humerus remains fixed against the neck of the scapula until the elbow is carried forwards and raised. The upper part of the capsule then relaxes, and the lower part, which remains tense, guides the head of the bone into the joint.

Smith's Method varies somewhat in its application, according to whether the head of the bone is displaced anteriorly or posteriorly. For anterior displacements the surgeon stands in front of the patient, and grasps the shoulder, using the right hand for the right shoulder and the left for the left, so that the thumb rests on the head of the bone, and the fingers grasp and steady the scapula. With the other hand he seizes the arm near the elbow which has been flexed, and raises it from the side, extending and everting it. Having thus raised it to a right angle, the limb is steadily and continuously circumducted inwards, the thumb following the head of the bone and assisting it to reach the lower and under side of the capsule, and thus enter the socket through the rent. For the subspinous dislocation, the surgeon stands behind the patient and grasps the shoulder with one hand, raising the arm with the other, and making extension backwards combined with external rotation; *i.e.*, the limb is circumducted outwards, and finally brought to the side.

2. *Extension* may be applied in different ways, the object being to overcome the tension of surrounding ligaments and muscles. It may be applied directly downwards by the surgeon grasping and pulling on the arm, whilst his unbooted foot is used as a counter-extending force in the axilla, the patient lying flat on a mattress placed on the ground, and the surgeon sitting by the side. Another plan consists in using the knee as a fulcrum instead of the heel, the patient sitting in a chair. Occasionally the foot has been placed against the thoracic wall, and extension made directly outwards at right angles to the body, as recommended by Sir Astley Cooper. White, of Manchester, suggested vertical traction, the arm being pulled directly upwards, the surgeon's foot having been placed over the acromion, the patient being in the recumbent posture. The

ction to this last method, which may succeed when other l, is that the axillary vessels are somewhat exposed to

tions of the Elbow-Joint are not very uncommon, occur- icularly in young people, and are due to either direct or riolence. The diagnosis is often difficult from the amount ıg that quickly follows. A careful investigation of the ıosition of the bony points (p. 497), and of the degree of of the different parts on each essential in order to arrive at a onclusion as to the exact nature ıion. In cases of doubt, a skia- uld be taken.

ɔcation of Both Bones may occur *kwards*, *forwards*, or *laterally*.

ckward variety (Fig. 165, A) is t often met with; it usually thout either the coronoid process cranon being fractured, although lly the former is detached. If oid remains intact, it sometimes locked in the olecranon fossa, ers the arm immobile; if, how- broken, considerable mobility of ıes occurs, with crepitus. The is semi-flexed, the hand held between pronation and supina- the displaced bones form a con- swelling at the back of the ɔve which is a marked hollow, y the triceps. The lower end of erus projects in front, and the d the soft parts are displaced forwards. The measurement acromion process to the external condyle remains un- ıut that from the condyle to the styloid process of the distinctly shortened, and the distance between the condyles lecranon process is increased.

FIG. 223.—REDUCTION OF BACKWARD DISLOCATIONS AT THE ELBOW.

ıtion **forwards** of both bones rarely occurs without fracture cranon process, although a few cases of this unusual accident ɔcord. The displacement is readily detected, the fore-arm gthened perhaps to the extent of an inch. The arm is in a of flexion, and, indeed, the accident can only take place ag backwards on the point of the elbow when in this position. ps muscle may be considerably lacerated.

dislocations of the fore-arm are almost always incomplete ot very frequent; the bones may be displaced either inwards rds, the latter being the more common. They are recognised ful examination of the relative position of the bony promi-

2. **Dislocation of the Ulna alone** occurs only in a *backwar* It is an occurrence of the greatest rarity, owing to the pc strength of the orbicular and oblique ligaments and of the in membrane. If, however, the bones of the fore-arm are rot wards upon the head of the radius as a fulcrum, and then th adducted, this displacement can occur without extensive li lacerations, which, indeed, have not been noted in any of observed.

In the **Treatment** of the above dislocations, all that is n to unhitch the interlocking bony prominences, so as to bones to return to their normal positions by muscular co This is usually accomplished by the method described by Cooper. The patient being in a sitting position, the surge backwards, with his kn bend of the elbow, ag lower end of the humer same time he grasps th wrist, and slowly and forc the fore-arm (Fig. 223).

FIG. 224.—DISLOCATION OF THE RADIUS FORWARDS. (PICK.)

3. **Dislocation of the Ra** may occur either *forw wards*, or *outwards*.

The **forward dislocatio** is that usually seen, a from falls on the hand fore-arm is in a state o pronation. The head of rests against the lower e humerus in the hollow above the capitellum, and the mc teristic feature consists in the inability of the patient to fle arm, owing to the bone impinging against the lower e humerus. It can be readily detected in this situation, rot the movements of the fore-arm, whilst a deep hollow is fe immediately below the external condyle. The fore-arm is flexed, and midway between pronation and supination; t act can be satisfactorily accomplished, but supination cannot further than half-way. A marked fulness exists on the ante of the limb when the arm is extended. Fracture of the u of the ulna sometimes accompanies this accident, especi produced by direct violence (Plate XXVIII.). If this luxa reduced, very great impairment of the mobility of the lin flexion beyond an obtuse angle becoming impossible. **Tre** Reduction is accomplished by traction from the wrist, witl arm flexed to a right angle, combined with pressure ove of the bone. Owing to the fact that the orbicular ligament is the deformity is very likely to recur, and hence active mo the limb must be interdicted for three or four weeks; a pa anteriorly over the head of the bone, and the limb flexed o

Dislocation **backwards** is less common. The head lies l

PLATE XXVIII.

ION OF RADIUS FORWARDS, AND FRACTURE OF UPPER THIRD OF ULNA.

external condyle on the outer side of the olecranon, where it can be detected on rotating the limb (Fig. 225). The fore-arm is flexed, and the limb pronated. Even if left unreduced, it leads to but little inconvenience.

Dislocation **outwards** is also rare, the head of the bone being displaced to the outer side of the external condyle, where it can easily be felt, causing considerable impairment of the natural movements. Reduction is accomplished without difficulty.

Occasionally a rare form of dislocation is met with in which the ulna passes backwards and the radius forwards, resulting in great deformity.

FIG. 225. — DISLOCATION OF THE RADIUS BACKWARDS. (DIAGRAMMATIC.)

A very common accident in children under four years of age consists of a **subluxation of the head of the radius downwards** within the orbicular ligament, so that a portion of it slips up and becomes nipped between the head and capitellum. It results from forcible traction of the hand, as from pulling up a child roughly after it has fallen, and is a common nursery accident, popularly known as **pulled elbow**. The limb becomes fixed in a position of slight flexion, and with the hand pronated, and the child cries out with the pain; it is readily treated by completely flexing the limb, and subsequently extending and fully supinating it, and leaves no bad results.

It must not be forgotten that we have here merely described the pure dislocations. In actual practice **complications** of a serious nature are frequently present in the shape of fracture of one or both condyles, which lead to much difficulty in diagnosis. These fracture-dislocations give rise to so much hæmorrhage that it is often impossible to come to a correct conclusion as to the nature of the case without the assistance of the Röntgen rays, and even then the results of treatment may be unsatisfactory. So much callus is formed, and fibrous adhesions of such strength are developed, that considerable impairment of function is almost certain to ensue. Probably the best line of practice is to keep the elbow at rest on a rectangular splint for a few days, to allow the immediate effects of the accident to pass off, and then to make an aseptic incision, dealing with the condition of affairs in the way best suited to the requirements of the particular case.

Dislocation of the Wrist is a very uncommon accident, and may occur *forwards* or *backwards*. The lower ends of the radius and ulna become prominent under the skin, and especially the styloid processes. By this means it is easily distinguished from a fracture of the lower ends of the bones.

Occasionally the radius, carrying with it the hand, is dislocated

from the lower end of the ulna, as a result of forcible pronati This is usually described as a *backward dislocation of the ulna*, and easily reduced by manipulation.

Dislocations of various Carpal Bones have been described, but t only one which is at all common is a displacement of the os magn backwards. It forms a rounded prominence under the skin in usual situation of the bone, which becomes more prominent flexion, and may disappear extension. As a rule, it readily reduced, but is v likely to recur.

FIG. 226. — DISLOCATION OF THUMB, SHOWING HEAD OF THE METACARPAL BONE PROTRUDING FORWARDS BETWEEN THE HEADS OF THE SHORT FLEXOR MUSCLE. (PICK.)

Dislocations of the Meta pal Bones and Phalanges not unfrequent, but need special mention, except in case of **Dislocation Backw of the First Phalanx of Thumb.** The chief inte here lies in the difficulty perienced in reduction, wh was formerly attributed to t head slipping between the t portions of the flexor br pollicis and being grasped b them, as a button in a butto hole. It has now been show that there are two much mo important factors, viz., th tension of the long flex tendon, which hitches rou the neck (Fig. 226), and th arrangement of the glen ligament. This fibro-cart ginous structure passes between the two heads of insertion of short flexor, and is thus incorporated between the two sesam bones; whilst firmly attached to the base of the phalanx, it is loosely connected with the head of the metacarpal bone, so th accompanies the phalanx in its dislocation, and will then be situ immediately behind the head of the metacarpal, so as to prevent attempts at reduction. **Treatment.**—Traction and manipulatio always attempted in the first instance. The thumb is grasp a suitable apparatus and hyper-extended to a right angle making the head of the metacarpal project still further throu muscular interspace, and, as it were, enlarging the buttonhol maintaining the traction, the thumb is rapidly flexed into th the metacarpal bone being at the same time pressed inwards. this fail, as it often will, a purified tenotome should be in the middle line of the thumb behind, immediately above of the phalanx, and should be pushed on till it reaches an

kely to occur.

nsidering these dislocations, the relative strength or weakness different parts of the capsule and its surrounding structures be remembered. Thus, the weakest part of the capsule is below and behind, and the fibres here are easily lacerated: it is through a rent in this part of the capsule that the head bone most frequently escapes. In front, the ilio-femoral or ed ligament of Bigelow, extending from the anterior inferior ine to the anterior intertrochanteric line, is a structure of strength, on the integrity of which depends the fact whether placed head of the bone shall occupy some definite position or ly moveable. Bigelow, to whom we owe so much in the tion of the mechanism of these dislocations, has divided them o classes—the *regular* and the *irregular*—according to whether gament is intact or completely lacerated. Posteriorly, the d tendon of the obturator internus is the most important re, and the position and level of the bone on the dorsum ilii ls in some measure on whether it remains intact or is ruptured. st also be remembered that the ligamentum teres is relaxed he thigh is forcibly abducted, and is made tense by adduction. r chief varieties of dislocation are described, in two of which ad of the bone is displaced posteriorly, and in two anteriorly. vo former are known as the *Dorsal* and the *Sciatic* varieties, gh *Dorsal below the tendon*, as originally suggested by Sir Astley r, is the better appellation for the latter variety. The two r dislocations are known as the *Obturator* or *Thyroid* and the in the former the head of the bone is located in the obturator and in the latter upon the pubic ramus. The relative fre- of these dislocations is as follows: About 50 to 55 per cent. cases are of the dorsal type, 20 to 25 per cent. sciatic, 10 to

e leg is placed on a boat just moving away from a pier on
e other is fixed. The direction of the violence, or the subse
anipulations performed by willing but ignorant friends, c
oluntary movements of the individual, determine what for
islocation is to be subsequently produced. If the limb is exte
otated and extended, the head travels forwards, and either the
or obturator variety results. If, hov
the leg is inverted and flexed, the he
the bone passes backwards, and eithe
dorsal or sciatic form is produced. A
in the posterior dislocations, if the obt
internus tendon remains intact, it may
across the front of the neck, and preven
further upward displacement of the
thus giving rise to the so-called s
variety; but if the tendon is ruptured,
the head of the bone slips in front of it,
is no obstacle to its upward displaceme
the dorsum ilii.

FIG. 227. DORSAL DISLOCATION OF THE HIP. (TILLMANNS.)

Dislocation may, however, also result
the limb is in a position of adduction, a
dorsal dislocation being thus produced, the
of the bone escaping from the capsule
the tendon of the obturator internus; su
accident is sometimes, but not always, a
ated with fracture of the posterior lip o
acetabulum. The type of violence lead
this occurrence is when a heavy weigh
on the back of a person whilst kneeli
when, his knee being fixed, the body is
forwards, so that the limb is forcibly in
If, however, the thigh is in a position
treme flexion, the head may be d
below the tendon of the obturator i
and the sciatic variety will then resu

1. **Dorsal Dislocation** (Fig. 227).—
of the bone in this form is found lyi
dorsum ilii, a variable distance a
behind the acetabulum, and alwa
the obturator internus tendon. It may be detected on m
of the limb, although in muscular subjects this is diffi
ligamentum teres is necessarily ruptured, as also the capsu
being situated either below or above the obturator tendo
to whether the dislocation is due to forcible abduction o
The small external rotator muscles are usually lacerated,
even the glutei and the pectineus. The ilio-femoral liga
remains intact. The great sciatic nerve is sometimes c
contused. The trochanter is raised above Nélaton's line
approximated to the anterior superior spine; the ilio-

therefore relaxed, and there is considerable shortening of amounting often to 2 or 3 inches. The leg is in a position , adduction, and inversion, so that the axis of the femur e lower third of the sound thigh. The knee is semi-flexed, all of the great toe rests against the opposite instep; the newhat raised. A marked hollow is felt in the upper part 's triangle, and the main vessels of the limb appear to be ed.

gnosis should be easy, the only difficulty being experienced iishing it from an impacted extra-capsular fracture. The of the accident, the presence of adduction and inversion, sed breadth of the trochanter in the case of fracture, and mally placed head of the bone in ı, are the points to which attention irected.

ic Dislocation, or dorsal below the one in which the head of the bone ed from travelling upwards to the ii by the integrity of the obturator endon. It may occur either from luction of the limb, or from extreme the adducted position. The lesions s and ligaments are practically the for the dorsal variety. The ilio- gament is uninjured.

ms resemble those of a dorsal dis- ut are less marked. There is less , often not more than ½ to 1 inch; is flexed, adducted, and inverted, is of the femur is directed across ite knee, and the great toe rests against the ball of the of the opposite side. The head of the bone is often much ct, owing to the greater thickness of the glutei muscles at

FIG. 228.—REDUCTION OF DORSAL DISLOCATION OF HIP. (BRYANT.)

nt of the Two Backward Dislocations is effected in much way, whether the dorsal or sciatic variety is present. The l method is that of *manipulation and rotation*, so accurately ıt by Bigelow. The patient is anæsthetized, preferably on s placed on the floor. The leg is first flexed on the thigh, high on the abdomen, the position of adduction being still d, so that the knee extends beyond the middle line of the . 228). This position is maintained for some moments, and limb is freely circumducted outwards, and brought rapidly) a position of extension parallel with the other. By this e the tense structures in front of the joint are relaxed, and ıead of the bone is made to retrace its course towards the ıe capsule, and finally directed upwards into the acetabular These movements are tersely summarized in Bigelow's words *p, bend out, roll out.*'

If this plan does not succeed, the following method of *traction* be employed. The patient, lying on his back, is firmly fixed bandage or towel passed over the pelvis and secured to two or t hooks or staples driven into the floor. The surgeon stands ove patient, whose thigh is flexed to a right angle on the abdome also the knee upon the thigh. The surgeon's arms are passed u the knee sufficiently far to enable him to grasp his own elbows, the front of the leg is steadied against the operator's perineum. D and forcible traction upwards can now be made, and this is

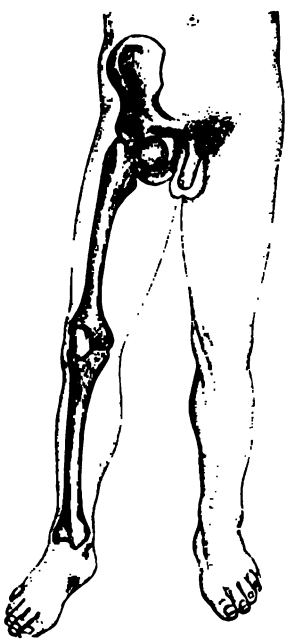


FIG. 229. DISLOCATION OF THE HIP: OBTURATOR VARIETY. (TILLMANNS.)

FIG. 230.- DISLOCATION OF T HIP FORWARDS: PU VARIETY. (TILLMANNS.)

sufficient in itself to lift the head of the bone into the acetabu If this is unsuccessful, the movements described above can be getically repeated in this position. The above plans, combined the use of an anæsthetic, rarely fail in reducing a backward di tion of the hip, and hence *extension by means of pulleys* is rarely req If, however, it is needed, traction should always be made in the tion of the displaced limb, *i.e.*, across the other thigh, counter-e sion being obtained by a jack-towel passed between the injured and the perineum, and fixed to a staple in the floor, close to the of the patient, and applied on the side of the dislocation. When cient force has been applied, the surgeon rotates the limb outw

so as to allow the head of the bone to once more slip into its socket.

3. **Thyroid or Obturator Dislocation** (Fig 229).—The head of the bone in this case passes downwards through a rent in the lower part of the capsule, and its position is subsequently but little altered, a slight forward and upward movement being alone superadded. The ilio-femoral ligament is untorn, but the pectineus and adductors are very tense, or may even be lacerated; the ligamentum teres is, of course, ruptured. The head lies on the obturator externus muscle, and can be detected in the perineum. The trochanter is less prominent than usual, and, indeed, its normal position may be represented by a depression. The limb is slightly abducted and everted, as well as lengthened, perhaps to the extent of 2 inches, though this is more apparent than real. It is also flexed, owing to the tension of the ilio-psoas muscle, and advanced before the other, with the toes pointing outwards. The adductor longus tendon stands out prominently, and much pain may be experienced from pressure on the obturator nerve. If the patient stands, the body is bent forwards, whilst it is interesting to note that if the dislocation remains unreduced the patient may be able to walk without much pain or inconvenience, though in a more or less stooping position.

FIG. 231. REDUCTION OF ANTERIOR DISLOCATIONS OF THE HIP. (BRYANT.)

4. **Pubic Dislocation** (Fig. 230).—In this variety the head of the bone lies on the horizontal ramus of the pubes, just internal to the anterior inferior spinous process of the ilium, where it can be felt rolling under the finger on any movement of the limb. The vessels are pushed inwards, and considerable pain may be felt down the limb from pressure on the anterior crural nerve. The ilio-femoral ligament is untorn, whilst the ligamentum teres and capsular ligament are ruptured; the small external rotator muscles, with the exception of the obturator internus, are usually torn. There is marked flattening of the hip, the trochanter being approximated to the middle line and raised. The limb is shortened to the extent of 1 inch, and there is considerable abduction and eversion, so that the inner aspect of the limb looks forwards. The thigh is slightly flexed to relax the ilio-psoas muscle.

Treatment of the thyroid and pubic dislocations is undertaken along similar lines as for the posterior dislocations. The patient is anæsthetized: the knee is flexed, as also the thigh upon the abdomen, but in a position of abduction; circumduction inwards follows (Fig 231), and on extension of the limb the head again enters the acetabulum. The thyroid variety may sometimes be reduced by upward and outward traction when the limb has been flexed to a right angle in the abducted position, the unbooted foot being placed against the pelvis to steady it.

If extension by pulleys is required in the thyroid di is made transversely outwards across the upper part of counter-extension being obtained by means of a band pa the abdomen. The limb, at first in a position of abduct sequently adducted forcibly by drawing the ankle inward by means of which extension is being made acting as a lever the head of the bone into the acetabulum. In the pr traction is made downwards, outwards, and backwards, ar of the bone drawn into its socket by a towel passed th across the limb.

After reduction of any form of dislocation of the hip, should be kept in bed with the legs tied together for about t and then passive movement may be commenced, but with able caution; voluntary movements should not be unde another week or two.

Should the dislocation recur, it may be due to fracti posterior lip of the acetabulum, or to some involuntary n of the patient, or perhaps to the fact that the displacem been fully reduced. Under such circumstances further a replacement should be undertaken, and the limb subsequ immobilized for a longer period than usual.

Irregular dislocations of the hip occur when the Y-shape is completely torn through, so that the head of the bone is not but can be moved round the acetabular cavity. Reductio easy.

Dislocation of the Patella may occur *outwards*, *inwards*, o A dislocation upwards resulting from rupture of the li patellæ is sometimes described, but it is scarcely to be i the same category as the others. The displacement may b or incomplete; in the former the capsule is always lacerat latter, not necessarily so.

The **outward** variety is much the commonest on acco obliquity of the limb, and may result from muscular action, in people suffering from genu valgum; it also arises fr violence. In either case it occurs most frequently when t extended, since during flexion the bone is firmly lodged in condyloid notch. When completely displaced, it lies upon surface of the condyle, with its inner margin projecting In this situation it is easily felt, whilst the knee appears and broader than usual, the intercondyloid notch being p tinguishable in the position usually occupied by the pate not unfrequently, however, incomplete, and then the inner l articular surface of the patella lies in contact with the car surface of the outer condyle, with its outer border projecting *Reduction* may take place spontaneously, but is usually e manipulation. The thigh is flexed on the abdomen, and extended, so as to relax the quadriceps, and then a little pr its outer margin causes the bone to slip back into place. complete form, where one of the borders of the bone is lod

yloid notch, reduction is sometimes very difficult, and to effect
operation may be required.

ward dislocation is rare, being always due to direct violence.
ters and treatment it is the exact converse of those met with
bone is displaced outwards.

cation edgeways, or **Vertical Rotation** of the patella, is an
condition in which the bone is said to be twisted vertically
own axis, and even to have been turned completely round.
e rotation is practically identical with that just described
mplete lateral dislocation, whilst the complete rotation of
must indeed be a rare accident.

ions of the Knee may occur *laterally*, as also *forwards* or
When due to disease of the joint, the backward dislocation
nest; but when arising from traumatic causes, the lateral
t frequent.

teral displacements are rarely complete, and are usually
with a certain amount of rotation; the leg is partially
Reduction is effected without difficulty.

tion of the tibia **forwards** is more common than displacement
s. It is generally complete, the lower end of the femur
into the popliteal space, and compressing the vessels, so
rene not unfrequently follows. The upper end of the tibia,
ith it the patella, lies in front, forming a well-marked swel-
a hollow above it. There is usually considerable shorten-
limb if the articular surfaces overlap.

tion of the tibia **backwards** is a much rarer accident, and is
lly complete (forty out of fifty-five cases were complete).*
s are exceedingly characteristic, the pressure effects upon
eal vessels and nerves often resulting in gangrene (ten
of fifty-five).

ion of either of these conditions is easily accomplished by
n the limb, whilst the thigh is flexed, combined with
tion in order to guide the head of the tibia into its normal
The limb must subsequently be kept at rest on a splint for
ree weeks.

ment of a Semilunar Cartilage (*Syn.:* **Subluxation of the
ernal Derangement of the Knee-Joint**) is a condition fre-
net with, resulting from sprains and strains associated with
In any rotary movement of the knee, which is only possible
limb is flexed, the pressure of the condyles always tends to
e position of the cartilages, which, moreover, are relaxed
freely moveable on the upper surface of the tibia in flexion
xtension. Displacement of a cartilage is almost always due
a strain or wrench of a rotary type, *e.g.*, turning quickly round
games as tennis, or slipping off the kerbstone with the knee
he internal cartilage is much more frequently affected than
nal, and the character and extent of the lesion varies much
nt cases. Not unfrequently its anterior tibial attachment is

* Sheldon, *Annals of Surgery*, January, 1903.

torn through, thereby permitting considerable lateral mol peripheral connections with the capsule and internal later may also be ruptured, whilst sometimes a portion is m detached from its free border, and in other cases the ca been broken across a little behind its centre. It is obvious once its connections have been loosened it can be displac and may pass into the intercondyloid notch, or may sli between the tibia and femur, or may even be doubled ov sequently becomes inflamed and swollen, and unless prop the displacement is likely to be repeated.

The **Symptoms** produced by this accident are a sudden pain of much severity, located in the knee, which become locked in a position of flexion, with inability to extend it. T may be able to 'wriggle' his joint free, or the limb may r for some hours, or even a day or two, when movement returns more or less spontaneously, a snap being at the felt within the joint. An attack of subacute synovitis usua In other cases the cartilage remains out of place, until redu surgeon, with or without an anæsthetic. If the case is no treated, the displacement is liable to recur, the cartilage slipping in and out, and getting nipped between the bone goes on, this becomes more and more easy, owing to the of the joint being relaxed from the recurrent attacks of syn fact, the limb may pass into such a state of chronic weal interfere seriously with the patient's comfort. There is spot of localized pain in the front of the joint, correspon upper surface of the tibia; possibly there may be some lateral mobility of the leg, and movement of the cartila detected on flexing and extending the knee.

The **Treatment** in the early stages consists in replacem cartilage by manipulation. The limb is fully flexed and the extended, pressure being applied at the same time in the hood of the displaced cartilage, which often returns into po a distinct snap. The limb is subsequently kept at rest splint, and cooling lotions are applied until the inflamm subsided; it is then further immobilized for some weeks i Paris or water-glass, so as to allow the lacerated ligament and consolidate. At the expiration of six or eight week accident an elastic knee-cap is applied, and the patient ag to move the joint.

When the cartilage has become loose and is constant out of place, immobilization of the limb, with pressure ov ful spot by an elastic knee-clip, as recommended by M Marsh, or by Hawksley's knee truss (Fig. 232), may Should this not prove satisfactory, operative proceeding undertaken.

The knee-joint is opened by an incision on the appropr the patella, more or less transverse in direction, and the c the cartilage ascertained. If of normal shape and merely

movable, it may be readily stitched to the periosteum over the head of the tibia, so as to keep it from again slipping between the bones; this is perhaps best accomplished by splitting the cartilage diagonally into two portions, and securing each of these by two or three catgut stitches. If, however, it is doubled on itself, or deformed, or if fixation seems impracticable, it may be removed; it is astonishing how well patients get on after such an operation.

The greatest care must be taken to maintain asepsis, and no strong or irritating antiseptic should be allowed access to the joint cavity, which is closed by a series of buried sutures, dealing in order with the synovial membrane, the capsule, the superjacent tendinous tissues, and, finally, the skin. It is advisable to drain the joint for twenty-four hours, and, as an additional precaution against infection, it may be well to immunize the patient by preparatory injections of antistreptococcic serum.

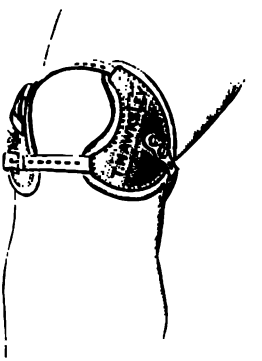


FIG. 232. KNEE TRUSS FOR DISLOCATED INTERNAL OR EXTERNAL SEMILUNAR CARTILAGES, OR FOR CHRONIC DISLOCATIONS OF THE PATELLA.

Rupture of the Crucial Ligaments is another form of internal derangement, resulting from great violence. The integrity and strength of the joint are much impaired, and abnormal lateral and antero-posterior movements are possible. Should the condition persist, the joint may be freely opened, and the ligaments sutured.*

Dislocations of the Ankle-joint may occur in the following directions: *outwards*, *inwards*, *backwards*, *forwards*, and *upwards*, this being the order of their frequency. Owing to the fact that the astragalus is wedged like a block into the mortice formed by the lower ends of the tibia and fibula, it is obvious that fractures of these bones are frequently met with as complications.

The **lateral** dislocations are in reality fracture-dislocations, and have been already described in the chapter on fractures (p. 559).

Although the upper articular surface of the astragalus is broader in front than behind, dislocation of the foot **backwards** is a more common accident than displacement forwards. It results from falls on the feet while running or jumping, or by sudden violence applied to the limb when the foot is fixed. Usually both malleoli are fractured, and the articular surface of the astragalus is thrown behind the lower end of the tibia. The heel projects unduly backwards, and the lower end of the tibia usually rests upon the neck of the astragalus, the scaphoid, or even the cuneiform bones.

Dislocation **forwards** is very uncommon, and may occur without any associated fracture of the bones of the leg. The foot is apparently lengthened, and the tibia rests upon the posterior part of the upper surface of the os calcis, behind the astragalus. The prominence

* Mayo Robson, *Annals of Surgery*, May, 1903.

of the heel and of the tendo Achillis is lost, and the normal
sion in front of the latter structure is occupied by the lower
the bones of the leg.

The *treatment* of antero-posterior dislocations consists in re
by traction. The leg is flexed upon the thigh, so as to relax th
Achillis, or, if necessary, this structure is divided. The ankle i
manded by a pair of Cline's side-splints, care being taken to as
that the foot is at right angles to the leg, and that the articular s
of the astragalus and tibia are exactly in apposition, thus prev
any displacement of the heel backwards or forwards. A Roug
splint—*i.e.*, an external splint with a sole-piece—is sometimes

FIG. 233.—DISLOCATION OF THE ASTRAGALUS FORWARDS.

A dislocation **upwards** has been described in which the astr
together with the foot, is carried up between the tibia and
To allow of such, the inferior tibio-fibular ligament and the lo
of the interosseous ligament must have been ruptured. Imprac
as such an accident appears, competent observers maintain th
have met with it. The displacement is very marked, a
character of the lesion very evident.

Dislocations of the Astragalus alone are by no means co
although their distinguishing features are well recognised.
consist in a partial or complete detachment of the bone from
normal connections, both to the bones of the leg and of th
and its displacement from under the tibio-fibular arch. It may
backwards or *forwards* with or without lateral rotation.

Dislocation **forwards** (Fig. 233) is much the more common
although it is usually associated with partial rotation, the di

ment occurring more frequently outwards than inwards. When complete, the bone is entirely detached from its connections with the os calcis, scaphoid, and bones of the leg, and lies upon the upper surface of the scaphoid and cuneiform bones, the skin of the dorsum of the foot being tightly stretched over it, or even torn. The limb is shortened, and the malleoli are approximated to the sole, the lower end of the tibia resting on the upper surface of the os calcis.

In the incomplete variety, the head of the astragalus impinges either upon the scaphoid on the inner side, or the cuboid on the outer, whilst the lower end of the tibia rests on the posterior half of the articular surface of the astragalus.

Dislocation **backwards** is almost always complete, and may or may not be associated with rotation of the bone, which can easily be felt between the tendo Achillis and the malleoli.

Treatment.—Reduction is only possible in the incomplete forms of dislocation. The patient is anæsthetized, the knee flexed to relax the muscles or the tendo Achillis divided, and traction upon the foot established, so as to enable the surgeon to apply pressure upon the displaced bone in a suitable direction. In the complete variety reduction is impracticable, owing to the fact that the os calcis is drawn up into contact with the malleolar arch. In such cases manipulation is useless, and excision of the bone is necessary. Comparatively little impairment in the function of the foot results from this operation.

Subastragaloid Dislocation.—By this term is meant a displacement of all the bones of the foot from below the astragalus, which retains its normal position between the malleoli. The interosseous and other ligaments passing from the malleoli and astragalus to the other tarsal bones are necessarily ruptured. The cause of this, as of other dislocations in the neighbourhood, is some violent strain or wrench of the foot.

Displacement of the foot may occur either forwards or backwards, but in the great majority of cases it is either *backwards and inwards* or *backwards and outwards*. The luxation is rarely complete as regards the calcaneo-astragaloid joint, but the articular surfaces of the head of the astragalus and scaphoid are completely separated, the former structure lying on the dorsal surface of the latter bone. The foot is greatly deformed, the anterior portion being shortened, the heel projecting, and the toes pointing downwards. The head of the astragalus is very evident, forming a rounded globular swelling under the tense skin. In a compound dislocation of this nature which we recently examined, *post-mortem*, the inner edge of the under surface of the astragalus had burst through the skin; the vessels and nerves were torn or stretched, and even when the wound in the skin had been enlarged, reduction was impossible owing to the tendons which had become caught around the neck of the astragalus. In such a case removal of the astragalus would have been the only practicable treatment.

In the **inward** displacements, the foot is somewhat inverted, so that the outer malleolus is unduly prominent, and the inner malleolus

is lost in a deep depression caused by the lateral displacement of os calcis; the foot is thus in a position somewhat simulating talipes equino-varus. In the outward dislocations the foot is everted, the inner malleolus prominent, and the outer buried, a position of talipes equino-valgus being thus assumed. In both forms the tendo Achillis is curved, with its concavity towards the displacement. *Treatment* consists in reduction by manipulation, which is sometimes readily accomplished, but may be a matter of the greatest difficulty, probably from the tibial tendons becoming hitched around the neck of the astragalus. Section of the tendo Achillis is occasionally needed.

CHAPTER XXII.

DISEASES OF JOINTS.

Acute Synovitis.

By **Synovitis** is meant an inflammation limited almost entirely to the synovial membrane, the ligaments and other structures of the joint being usually but little affected.

The **Causes** are local and general. Local conditions include cold and injury; general or constitutional comprise rheumatism, gout, syphilis, pyæmia, and gonorrhœa.

Pathological Anatomy.—Acute synovitis results in hyperæmia of the synovial membrane, and exudation of plasma and leucocytes, firstly into the substance of the membrane, causing it to be thickened and spongy, and subsequently into the joint; the endothelium also proliferates, and is shed. In the early stages the effusion consists of synovia, diluted with blood plasma, and often discoloured with blood in traumatic cases, and hence on removal is spontaneously coagulable; after a time the plasma may coagulate, depositing lymph upon the articular surface, whilst serum remains. The lymph thus deposited may either be removed by a natural process of absorption when the inflammation comes to an end, or it may organize, so as to form adhesions. In the later stages the synovial membrane becomes somewhat thickened, and the ligaments possibly a little infiltrated and relaxed.

The **Clinical Signs** of acute synovitis consist in the joint becoming painful and distended, whilst if the articulation is superficial, as in the knee, a sense of heat may be imparted to the hand, and the surface may even be red and hyperæmic. The limb is maintained by muscular spasm in that position which gives the most ease, viz., that in which its capacity is the greatest, and this is usually one of slight flexion, but if the condition is neglected, the flexion may increase considerably, the muscles undergoing tonic contraction, and the limb remaining more or less fixed in an undesirable position. The muscles governing the movements of the joint occasionally undergo rapid atrophy, probably resulting from a reflex disturbance of their trophic centres in the cord.

Evidence of Effusion into Various Joints.—*Shoulder:* The curvature of the shoulder is increased, and the deltoid expanded by a fluid swelling beneath it, which is especially noticeable at its anterior border along the bicipital groove, and sometimes posteriorly; in the

axilla a painful intumescence may also be felt. These sympto
may be somewhat simulated by inflammation of the multilocular s
deltoid bursa, but the latter condition is recognised by the absenc
any axillary swelling, by its not encroaching on the anterior
posterior borders of the deltoid, and by the fact that, although w
the patient voluntarily moves his arm pain is produced, yet when
surgeon gently manipulates it, so as to press the head of the h
against the glenoid cavity, there may be none. *Elbow:* The hol
on either side of the olecranon and tendon of the triceps are repl
by soft fluid swellings, the outer of which also extends down to,
masks, the head of the radius; there is usually a little general p
ness in front of the joint. It is readily distinguished from inflam
tion of the olecranon bursa by the fact that in the latter condi
there is a central fluid prominence over the bone, whilst in the fo
the swellings are placed on either side of and above the bony
jection. *Wrist:* There is a general fulness both on the anterior
posterior aspects of the joint, whilst fluctuation may be dete
beneath the dorsal tendons, which are slightly separated and
placed. It is distinguished from synovitis of the superjacent te
sheaths by the fact of its strict limitation to the neighbourhood o
joint, and the absence of the superficial crepitus, so characterist
the latter condition. Effusion into the *Hip-joint* cannot be e
detected by digital examination. There may be a little fulness
tenderness in the gluteal region, or in the upper and outer pa
Scarpa's triangle. The most characteristic feature, however, i
position of flexion, abduction, and eversion taken by the limb, w
limitation of movement is equally marked. The *Knee*, when diste
with fluid, presents a rounded outline, in which all the normal hol
especially those on either side of the patella and ligamentum pa
have disappeared. There is also a swelling corresponding t
subcrureal pouch, more marked on the inner than the outer side
extending for 3 or 4 inches above the patella. Fluctuation ca
readily detected when one hand is placed above the patella, an
fingers of the other hand compress the tissues on either side o
ligamentum patellæ below, or by alternate pressure on either si
the rectus tendon. When the effusion is considerable, the pate
felt to float, and on pressing it sharply backwards can be made t
against the intercondyloid notch of the femur (*patellar tap*). A sm
effusion is recognised by pressing the fluid downwards from the
crureal pouch with the knee fully extended, when the patellar ta
usually be demonstrated. Enlargement of the bursa patellæ is re
nised by the swelling being central and in front of the patella, so
its outline is obscured. *Ankle:* The hollows between the te
Achillis and the malleoli are replaced by fluctuating swellings, w
the dorsal tendons are displaced forwards, and a fluid swelling ap
in front of each malleolus. Enlargement of the bursa beneath
tendo Achillis is so obviously confined to the back of the joint th
should never be mistaken for true synovitis of the ankle.

When the acute stage has passed, the joint is usually left

weak and relaxed condition, with a little passive effusion, s some adhesions. The *adhesions* which follow acute syno- usually slight in character, if the case has been properly hey result from the union of patches of lymph on opposing f synovial membrane or bone, which become organized into o-cicatricial tissue, containing a few delicate bloodvessels, ed by endothelium extending over them from the adjacent mbrane. The characteristic signs of such a condition are mitation of movement in some particular direction, and little soft crepitus.

eatment of acute synovitis consists in so immobilizing the) give the patient the greatest amount of ease, whilst, should result, the limb is left in as favourable a position as possible quent utility. Thus, the *shoulder* should be bandaged to the the hand kept in a sling; the *elbow* is placed on an internal plint, and flexed to a little more than a right angle, whilst is midway between pronation and supination; for the *wrist* s needed is to apply a palmar splint to the fore-arm; the mobilized by the application either of a Thomas's splint Liston's long splint, or by placing the limb between sand- adjusting an extension apparatus; the *knee* is put on a at, perhaps slightly flexed; whilst the *ankle* is best kept at plying what is known as a Roughton's splint, *i.e.*, an external th a foot-piece. Necessarily, in all severe cases of acute the patient should be confined to bed and the limb elevated. se has been neglected and the limb has assumed a vicious the patient should be anæsthetized and the malposition ; or gradual extension is made by means of a weight and til the correct position is attained. In the early stages cold e applied to the joint by means of evaporating lotion, an Leiter's tubes, but this is not advisable in old people. In stages fomentations give greater relief, whilst the application leeches may also be beneficial. When the distension is con- , removal of some of the fluid by a carefully purified aspirator, and cannula, may diminish pain and hasten recovery.

subacute stage, when the joint is weak and relaxed, massage n with stimulating liniments should be employed, whilst in chronic forms firm pressure, and preferably by means of a bandage, is most useful as an additional measure.

esions are present, they should be carefully broken down loroform; the limb is subsequently kept at rest for a few on a splint, whilst passive movements and massage are ds adopted.

Chronic Synovitis.

affection follows an acute attack, or may be lighted up by jury or condition insufficient to determine a more violent form mmation. The synovial membrane becomes thick and infil- whilst the effusion is sometimes relatively less than in the

acute form, sometimes excessive, then constituting the co described as *chronic serous synovitis* (Fig. 234), a phenomeno seen affecting the knees after rising from a prolonged stay The pain is usually not being replaced by a sense lessness and weakness. I teresting to note that, in where the effusion is well r the bursæ communicating v joint frequently become dis they are prevented from pating in the acute forms flammation by the fact th apertures of communicatio the interior of the joint are and slit-like, and thus rea come occluded by the swe the membrane. Crepitus i times met with in chronic sy possibly from a roughening articular surfaces on which has been deposited, or b which fibrous adhesions formed.

FIG. 234.—CHRONIC SEROUS SYNOVITIS OF KNEE, WITH DISTENSION OF THE SUBCRUREAL POUCH. (FROM COLLEGE OF SURGEONS' MUSEUM.)

Occasionally the synovial become hypertrophied, giv to a condition similar t described under osteo-a (p. 672). The overgrow usually spring from the ref of the synovial membrane the bone, and may be load fat, constituting the condition known as 'Lipoma arborescen the knee-joint the fringes may be felt rolling under the fing painful symptoms may be caused by the loose ends being cau nipped between the bones.

Treatment consists in fixing the joint in a suitable positi applying counter-irritation and pressure; Scott's dressing and are especially useful in this affection. At a somewhat late elastic pressure by a Martin's bandage may be employed, t with friction with stimulating liniments, or even hot-air baths moval of some of the fluid by aspiration and subsequent comp may also do good; but if the affection resists such treatm best procedure consists in opening the joint, washing it ou sterile saline solution, and draining it for a few days.

Should enlarged villi be present and give rise to trouble, th should be opened, and if they are limited in their distributi may be clipped away, or the synovial membrane from whi grow dissected out. When very extensive, so that removal

total excision of the synovial membrane and consequent
, it may be wise to wash out and drain, in the hope that
ıy become fixed, before undertaking complete extirpation of
nbrane.

ırthrosis (Hydrops Articuli) is the term applied to any
ın of a chronic nature in which the joint is much distended
ıid. It may arise from at least five different affections:
ɔnic serous synovitis; (*b*) in osteo-arthritis, a very common
(*c*) in Charcot's disease; (*d*) in secondary syphilitic synovitis;
ɔccasionally in tuberculous disease. It must be remembered
s but a symptom, and not a disease *sui generis*, and treatment
rily varies with the cause.

235.—Baker's Cysts from Back of Knee. (Howard Marsh.)

's Cysts.—This condition, first described by the late Mr
: Baker, consists in a hernial protrusion of the synovial mem-
f a joint through an aperture in its fibrous capsule (Fig. 235).
ıally due to some chronic affection of the articulation, espe-
steo-arthritis or tuberculous disease, whereby the intra-
: pressure is increased, and not uncommonly several such
: connected with the same joint. They vary much in size,
synovial fluid, and, though at first communicating with the
vity, have a tendency to travel away from it, burrowing
ıuscular and fascial planes, and coming, perhaps, to the
some distance from their origin, the aperture of communica-
h the joint having in some instances been shut off. If causing
ɔlesome symptoms, there is no necessity to interfere; but if
ɔome inconvenient or painful, it is easy to dissect them out,
where necessary by ligature or suture the narrow neck which

leads into the joint. Of course, the strictest asepsis must be maintained in all such proceedings, and the causative affection must not be forgotten.

Acute Arthritis.

By the term **Arthritis** is meant any inflammation of a joint which involves all the structures of which it is composed, viz., bones, ligaments, cartilages, and synovial membrane.

Causation.—Acute arthritis is practically always due to infection of the joint cavity with bacteria, which reach it either from within or without the body. (i.) It may be due to the entrance of cocci through a punctured or valvular wound of the joint, or during operations. It is interesting to note how extremely prone to inflammation is the synovial membrane when opened, even after the most careful antiseptic precautions. The micro-organism most commonly present is a modification of the *Streptococcus pyogenes*, but various other pathogenic organisms have also been found in special cases. (ii.) It may arise in a manner exactly analogous to that in which acute infective osteo-myelitis is produced—*i.e.*, the patient is in a low state of health, his natural germicidal powers are diminished, pyogenic organisms are present in the blood-stream, gaining access through some breach of surface, and, finally attacking any weak or damaged tissue, produce therein suppurative inflammation. A slight injury, *e.g.*, a sprain or strain occurring in a weakly child, convalescent from measles or scarlet fever, may result in this affection. (iii.) It may be produced by the lodgment of a pyæmic embolus, and in a similar way it not unfrequently follows as a sequela of fevers, such as enteric or pneumonia, by direct transmission of some infective material. (iv.) It is sometimes met with as a result of gonorrhœa, and may then run its course with or without suppuration. (v.) It may be lighted up as a result of the extension of inflammation from the end of a neighbouring bone, or from the bursting of a subcutaneous or bursal abscess into the joint. Acute arthritis of the hip-joint is commonly due to the former of these conditions, being consecutive to an acute infective osteo-myelitis of the upper end of the femur. (vi.) It is occasionally observed as a result of *rheumatism*, the inflammation running a very acute course, and leading to disorganization of the joint, though without suppuration. Such attacks are undoubtedly bacterial in origin.

Course of the Case.—In the early stages acute arthritis manifests itself as a hyperacute synovitis, combined with severe pain and fever. The pain is often so intense that the patient cannot bear the part to be touched or the bed shaken, and indeed the slightest jar of the limb is so exquisitely painful that the patient may scream with agony. The joint itself is distended with a turbid effusion, which rapidly becomes purulent, and the tissues around are hyperæmic and œdematous. The patient naturally places himself in that position in which the limb obtains the greatest ease, and therefore usually semiflexes the joint and fixes it by muscular contraction.

e disease progresses, pus is formed within the capsule, through it, and either travelling directly to the surface, or g deeply into the substance of the limb; thus, in the knee ious abscess may collect beneath the vasti muscles, stripping m the bone for a considerable distance. The pain increases e abscesses are forming, and becomes especially distressing the patient being often waked by a painful start just as he asleep. This condition usually indicates that the articular are becoming affected, and is explained by the fact that, he patient loses consciousness, the muscles which fix the relaxed, and allow the inflamed surfaces to shift their slightly, exciting severe pain and a sudden spasmodic con- of the muscles. Gradually the deformity becomes more and ious, whilst the infiltration and relaxation of the ligaments s allow of abnormal movements, *e.g.*, of lateral mobility in joint; the ends of the bones become carious, and absolute ent or dislocation may follow. Sinuses may open in all s, and the patient suffer from recurrent rigors, caused by or the onset of pyæmia. The constitutional effects are evere, consisting of high fever, and rapid exhaustion from sleeplessness, and absorption of toxins.

rminations of this affection are as follow: (*a*) Recovery, th a moveable joint, and then only after active interference; ases ankylosis in a good or bad position, according to the t, is the best result that can be expected. (*b*) During the ge the patient may die of pyæmia, or acute toxæmia and n. (*c*) If he survive the acute stage, chronic suppuration ie, and symptoms of hectic and amyloid degeneration in the nay supervene. In such cases sinuses leading down to ones exist, and, unless efficient measures are taken to obtain r to remove the diseased structures, perhaps by amputation, nt is likely to die from exhaustion or chronic sapræmia.

gical Anatomy.—The *synovial membrane*, at first merely d and hyperæmic, soon becomes converted into granulation m within outwards, exuding abundant pus. The *ligaments* re sodden and relaxed by the presence of a plastic exudation the fibres, rendering them soft and œdematous, so that the ntraction of the muscles easily stretches them and brings splacement.

ticular cartilages are disintegrated and destroyed in various cording to the acuteness of the inflammation and the amount ure to which they are exposed. In acute cases they early r normal bluish-white appearance, and become opaque and yellow. The central parts, which are exposed to pressure the ends of the bones, soon disappear, whilst the peripheral are eroded by the growth of the granulation tissue develop- the synovial membrane. When once the cartilage has been ed at any one spot, the suppurative inflammation spreads s under surface, stripping it from the bone, and thus inducing

sis, as a result of which isolated portions of dead ca ound lying in the joint. In the more chronic fo ase, proliferation of the cartilage cells occurs, w sules become distended, and the matrix encroached u hese cavities burst into the joint, and leave more or ıped openings into which pyogenic organisms find the gravating the mischief; others nearer the deep as cartilage become transformed into tissue by vascularization from th the bone. In these ways the cart stroyed or replaced by granulatic proceeding analogous to ulceration parts. The *interarticular cartilages* in a very similar manner, and quickl

FIG. 236.—ENDS OF THE BONES AFTER ACUTE ARTHRITIS OF ELBOW, SHOWING THE CARIOUS SURFACES DEVOID OF CARTILAGE, AND THE DEVELOPMENT OF STALACTITIFORM OSTEOPHYTES. (FROM KING'S COLLEGE HOSPITAL MUSEUM.)

The *ends of the bone* pass into a acute osteitis, resulting in the trans the medulla into granulation tissue of the bony cancelli with or witho tion, and sometimes necrosis of sm of the cancellous tissue (*caries nec* veins within the cancelli become t and hence pyæmia may result, Th covering the ends of the bones is a and hyperæmic, in consequence of v lated or stalactitiform osteophytes a (Fig. 236). The *muscles* in the nei of the joint undergo rapid atroph degeneration, probably as a res reflex disturbance of the trophic c

Treatment.—In the early sta must be elevated, absolutely imm put into such a position that, if sequently obtains, it may be of s patient. Fomentations or an i applied temporarily, but as soo toms point to suppuration, the freely opened in one or two pl with some sterile or antisept drainage-tubes inserted, whils peri-articular abscesses are d same way. Openings should p on opposite sides of the joint, cavity to be flushed out fre sidered desirable, for continuous irrigation of th mild antiseptic (*e.g.*, weak boracic lotion, or subl 8,000), or some bland unirritating fluid, such s saline solution. The fixation of the limb is r general health attended to. Irrigation should b signs of inflammation, pain, heat, and startin

l away. Under such a régime it is sometimes possible to a moveable joint, but more frequently ankylosis must be ed. Excision may be required in order to prevent or remedy nkylosis, or to place the limb in a good position; it is also ıken in some cases of chronic suppuration, with caries of ls of the bones and displacement, but, as a rule, not until all ymptoms have passed away. If the patient is suffering from toxæmic or pyæmic symptoms threatening life, amputation required, as also for exhaustion from long-standing suppura- d hectic fever.

Acute Arthritis of Special Joints.

e **Shoulder**, infection sometimes occurs through the axilla where sule is weak and easily invaded by organisms, as after an cellulitis; more frequently it follows a penetrating injury. pain is caused by any movement of the arm affecting the ıd the pus in the distended synovial membrane comes to the in front of or behind the deltoid or in the axilla. It may to open the articulation anteriorly and flush it out, but, if , a counter-opening should be made behind by cutting down ir of dressing-forceps pushed backwards through the capsule. y instances the patient's condition will not improve until the the bone has been excised. The subsequent results as regards ent and power of the arm are, on the whole, very satisfactory.

e **Elbow**, there are no points requiring special mention as to history or results, although it must be remembered that the r radio-ulnar articulation is necessarily involved, and hence ver of pronation and supination of the hand is threatened. As ment, incisions should be made on either side of the olecranon, ar nerve being avoided. The limb is then placed on a rect- r splint, and with the hand midway between pronation and ion; of course, the patient is kept in bed, with the arm raised llow. In an adult excision may be undertaken as soon as the tage has passed, in order to obtain a moveable elbow; but in n, where the growth is incomplete, it is better to allow ankylosis ır, and excise, if need be, at a later date.

Wrist may be infected secondarily to septic conditions follow- erations on ganglia in the neighbourhood, or through direct . The essential treatment consists in free incisions parallel he tendons, and avoiding the sheaths. Ankylosis usually results, xcision is not resorted to except when the disease has become hronic, with extensive caries of the carpus.

ute arthritis of the **Hip-joint** is usually a sequela of acute infective myelitis attacking the upper end of the shaft of the femur, and ving the joint, owing to the epiphyseal cartilage being intra- ılar; it also results from pyæmia, and rarely from penetrating ies. The symptoms are similar to those of the first stage of ary tuberculous disease (p. 686), but much more acute. There gh fever, together with intense pain, marked flexion and eversion

shaft. A double opening may sometimes be utilized with a

The **Knee-joint** is more frequently involved by this disease other, and is usually infected from without. The symptom ceedingly typical: the pain is very acute and the joint ho tended to its utmost capacity, the limb lying semiflexed a outer side. Left to itself, the capsule gives way, and su rapidly extends upwards beneath the vasti or downwards in the pus ultimately finding its way to the surface. The gradually increases, until in the worst forms the tibia sli the condyles of the femur, the leg is flexed to a right a rotated outwards, and if the limb has long rested on its o considerable lateral displacement may also occur. Early an treatment will usually prevent such a disaster. The joint freely incised on each side of the patella, so as to open up crureal pouch, and the whole articular cavity well washed some cases a counter-opening may be made with advanta drain-tube inserted, by passing a pair of sinus forceps thr outer portion of the posterior ligament of Winslow, an down on it to the inner side of the biceps tendon and cl external popliteal nerve. By this means more efficient dr the articular cavity is obtained.

When the **Ankle-joint** is involved, amputation has oft resorted to, in consequence of the difficulty of securing good although excision of the astragalus will sometimes cut disease and lead to a good result.

Special Forms of Synovitis and Arthritis.

Rheumatic Synovitis is met with in the course of acute rh or as a chronic affection from the commencement. The recognised by the presence of fever, acid sweats, high-colo loaded with lithates, and a tendency to metastasis, one

apsular and other ligaments. If neglected, it may produce
the joint, due mainly to ligamentous changes, but also
from the development of intra-articular adhesions; but there
any lipping of the cartilages or new formation of bone, as in
hritis. Not unfrequently other evidences of rheumatism may
it, such as chorea, erythema, etc., whilst rheumatic nodules*
growths of fibrous tissue beneath the skin, perhaps reaching
of a walnut, but more often much smaller) may also develop.
reatment of the acute form is medical rather than surgical,
ral rather than local. The affected joints must be kept at rest
osition, and wrapped in warm cotton-wool, or, perhaps better,
entations may be applied. Should the inflammation resist
asures, it is quite justifiable to open and wash out the joint,
found to be occupied by a greenish, semi-puriform effusion.
more chronic forms anti-rheumatic drugs have less power,
attention must be paid to diet. Butcher's meat, sweets,
dishes should be avoided, and as far as possible a 'white
ained. Mineral waters are exceedingly valuable, and a visit
able home or Continental spa may be desirable. Locally,
and stimulating embrocations do good, but in bad cases
rritation by repeated blisters, or even by applying the actual
is desirable. Malposition may be corrected under an anæs-
by weight extension. Localized hot-air baths (Sheffield-
n system, or Dowsing's radiant electric heat) do good in
es.

Arthritis is characterized by certain well-marked features.
ttacks the metatarso-phalangeal articulation of the great toe
), or the metacarpo-phalangeal joint of the thumb (cheiragra).
is usually sudden, and it frequently commences in the
f the night. The tissues around the joint become swollen,
y, and œdematous, whilst the superficial veins are prominent.
ck is exceedingly painful, and the skin exquisitely tender.
mptoms pass off in the course of a few days, leaving the
on swollen and sensitive.

a single attack results in a slight deposit of bi-urate of soda
ar crystals in the matrix of the articular cartilage close to the
but when the joint has been several times inflamed, the whole
s of the cartilage may be invaded by this chalky deposit,
e ligaments and ends of the bones are also infiltrated. In
ler joints it may increase to such an extent as to form well-
swellings, or 'tophi,' similar in character to those so com-
en in the external ear. The skin sometimes gives way over
d a chalky discharge results. In some cases the cartilages

*annatyne's opinion as to the diagnostic value of fibrous or bony sub-
nodules connected with articular lesions is as follows: 'Muscular
are most often due to rheumatism, small subcutaneous nodules also to
m, larger ones to rheumatoid arthritis, bursal enlargements to chronic
umatoid arthritis, or rheumatism, and bony nodes (of the Heberden
hronic gout or chronic rheumatoid arthritis.'

are eroded, and eburnation of the exposed bone may fol
osteo-arthritis. The *treatment* of acute gout consists i
ing the parts or applying glycerine of belladonna, whilst
citrate of lithia, and alkaline purgatives are administered
more chronic forms iodide of potassium may be given, an
and drink are carefully regulated. Probably some form
therapeutic treatment will be required, and if the patient
to a suitable spa much may be done at home by getting hi
a large cup of hot water half an hour before each meal.

Pyæmic Synovitis is due to embolic infection from some su
focus. The joint becomes rapidly distended with pus, and c
out pain. If the joint is promptly opened, washed out an
its disorganization may be in many cases prevented (*vide*
p. 83); otherwise destructive changes will quickly follow.

Typhoid Disease of Joints.—1. A *simple chronic synovitis*
one or more joints, with but slight effusion and little infl
disturbance. It is somewhat resistant to treatment, and h
cause limitation of movement. Possibly it is due to the
toxins rather than of the living organism. 2. The *true typhoi*
due to the *B. typhosus*, is characterized by a marked infl
effusion into one or more joints, and is liable to end in sp
dislocation, especially in the hip-joint. Suppuration, howev
and the prognosis favourable, provided the limb is kept i
position. The presence of a large effusion indicates aspirati
mixed pyogenic and *typhoid* infection results in active suppurati
the joints, the *B. typhosus* playing quite a subsidiary part.
pyogenic infection. In these latter two varieties the ordin
toms of acute suppurative arthritis occur, and the treatmen
affection must be instituted.

Pneumococcal Arthritis.—In the course of an acute pneu
pneumococcus is occasionally disseminated through the bod
then very likely to attack a joint which has been already
giving rise to a suppurative arthritis with an effusion of thic
pus, or sometimes to a milder form of synovitis. Males
often affected than females, and the upper rather than t
extremity. Occasionally more than one joint is involved,
the exception of the hip, the larger joints are attacked ra
the smaller. There are no special peculiarities in the dis
since it is merely part of a general infection, a high mortalit
ciated with it. Suppuration usually occurs, and its onset i
an indication for incising, washing out, and draining the joi
It may also occur primarily and apart from any other
pneumococcal lesion. The symptoms are then those of a
arthritis with effusion, which may be so resistant to treatm
require arthrotomy. Some limitation of movement is likely

Gonorrhœal Disease of Joints is always due to infection
gonococcus, transmitted by the blood from the primary foc
chief. Whilst usually seen in connection with gonorrhœal
in males, it has been known to follow ophthalmia neonatorum

hted up by passing a full-sized bougie on a patient with gleet. ally commences after the third week of the gonorrhœal attack, e discharge is becoming subacute. It may involve one or many he knee, ankle, and wrist being most frequently affected, and on both sides of the body. Two distinct types of trouble nifest themselves, but they are not unfrequently combined. the synovial membrane is mainly affected, and the effusion ly intra-articular, so that the condition closely resembles an attack of acute traumatic synovitis. In the other, the peri- r structures bear the brunt of the mischief; and there is at little effusion *in* the joint, but much around it, the parts even g œdematous; the ligaments are infiltrated and softened. displacement readily occurs; surrounding muscles atrophy ; the patient suffers from severe pain and fever, so that he s thin and worn. In the worst cases the intra-articular effusion s, and is sero-purulent, yellowish-green in colour, and contains f lymph, but it is never truly purulent. Both forms are very and resistant to treatment, and hence ankylosis, with or with- rganization, is very liable to follow. **Treatment** is not very ory. The urethral discharge must be arrested as soon as , whilst the affected joints are kept at rest; moderate pressure nter-irritation, as by Scott's dressing, are perhaps the best f dealing with the later stages in simple cases. Iodide of m, mercury, and quinine may be administered internally. the local phenomena be at all severe, the joint must be opened, l, and drained, and if undertaken sufficiently early ankylosis prevented.

Tuberculous Disease of Joints.

culous Arthritis (*Syn.:* **Pulpy Degeneration of the Synovial ne, White Swelling,** etc.) may commence either in the synovial ne or in the articular end of the adjacent bone (tuberculous itis, p. 591); or it may spread from the periosteum to the l membrane, as a result of a tuberculous periostitis, or from a uring bursa. There is some slight difference of opinion as to tive frequency of the synovial and osseous varieties, but the vestigations certainly seem to indicate that in children the commences most frequently in the epiphyses, whilst in adults tart either in membrane or bone with about equal frequency. **Causes** may be summed up as follows: The individual is pre- l to the development of tuberculous disease, usually as the f an inherited tendency, a family history of tubercle being often ble; the general health of the patient may be at fault, owing fficient or inappropriate food, bad hygienic surroundings, or e to cold. Some slight injury of which but little notice is nay lead to the actual deposit of the *B. tuberculosis*, which ccess to the body through some breach of surface, or even per- rough a healthy mucous membrane. Severe articular lesions.

such as dislocations, are much less likely to induce tuberculous disease, partly because their gravity demands efficient treatment, partly because the activity of the reparative process is capable of dealing with the organisms, even if they are brought to the spot.

Pathological Anatomy.—The *synovial membrane* becomes thickened, pulpy, and œdematous, and in the early stages, on naked-eye examination, may be found to be studded with small gelatinous nodules, about the size of a pin's head, situated immediately beneath the serous lining; later on, these may amalgamate into caseous masses, which burst and discharge into the joint, leaving ulcerated surfaces. Finally, the synovial membrane is changed into a so-called pyogenic membrane, consisting of granulation tissue similar to that lining the cavity of a chronic abscess, and more or less closely attached to the surrounding structures, which are transformed into œdematous fibro-cicatricial tissue, whilst the superficial parts undergo fatty or necrotic changes. Microscopically, one finds all the ordinary appearances of tuberculous disease, the vessels being in a state of endarteritis for some distance from the serous surface. Fringes of the synovial membrane, swollen and succulent, spread over the margins of the *articular cartilage*, and as they increase in size become adherent to it, just as, according to Billroth's classical description, ivy creeps along a wall. On lifting the edges of these fringes, the underlying cartilage is found hollowed out and eroded. As soon as the whole thickness is destroyed at any one spot, the cancellous tissue at the *end of the bone* becomes similarly affected, and the granulations spread along under the cartilage, cutting it off from its nutritive supply, and thus large flakes of necrosed cartilage may be shelled off, a process specially seen in the hip-joint. As a result of the hyperæmic condition of the end of the bone, especially when sepsis is superadded, a new formation of subperiosteal osteophytes, stalactitiform in character, sometimes takes place, but not to such an extent as in acute arthritis. Occasionally the periosteum itself is involved in the tuberculous process, and the disease may then extend some distance from the joint.

When the bone becomes involved, either primarily or secondarily, any of the manifestations of tuberculous disease described in Chapter XX. may be met with, and thus it is not uncommon to find sequestra in connection with tuberculous arthritis. When it originates in the bone in adults, the tissue directly contiguous to the articular cartilage is often that primarily attacked; but in children it more frequently starts in connection with the epiphyseal cartilage. The joint is usually infected by extension of the disease through the articular cartilage, but when the synovial membrane extends along the bone beyond the cartilage, it may become involved without any cartilaginous lesion. In the early stages a simple synovial effusion may occur, but gives place to the more typical manifestations when infection has followed. Occasionally a tuberculous abscess bursts into a joint, acute symptoms supervene, but gradually quiet down, and the usual chronic phenomena subsequently develop. More commonly the infection is slow and gradual, and the

onset of the articular symptoms is of a similar character. The extent of the mischief in the bones may sometimes be ascertained by the radiography (see Plates XXIX. and XXX.).

Clinical History.—The disease usually commences in a most insidious manner. It may be dated back to some injury, but as often as not no such occurrence has been noted. Slight impairment of movement, together with some pain, especially when the limb is jarred or twisted, is perhaps the first sign, causing the patient to limp if one of the lower extremities is involved. This limitation of movement is usually manifested in *all* directions, and this will often assist in diagnosing it from the fixity due to the presence of adhesions in a simple chronic synovitis. The amount of rigidity varies much; in a purely synovial lesion the movements may at first be but little impaired and painless, although the whole region of the joint may be puffy and swollen; when, however, the bone is affected, either primarily or secondarily, the limitation of movement is considerably increased. The position of the limb is that which will give the greatest amount of comfort, and varies in different joints (*q.v.*). On inspection a superficial joint, like the knee, looks white, smooth, and rounded, the swelling being more apparent on account of the wasting of adjacent muscles. On palpation, the part is found to be hotter than that on the opposite side of the body, whilst fluctuation is not readily detected, there being but little fluid in the joint, though the affected tissues are elastic and puffy. In a few rare cases, where the synovial membrane is widely involved, the affection commences with considerable serous exudation, giving rise to the condition known as tuberculous hydrops; after persisting for a while, the usual manifestations of the disease show themselves. According to König

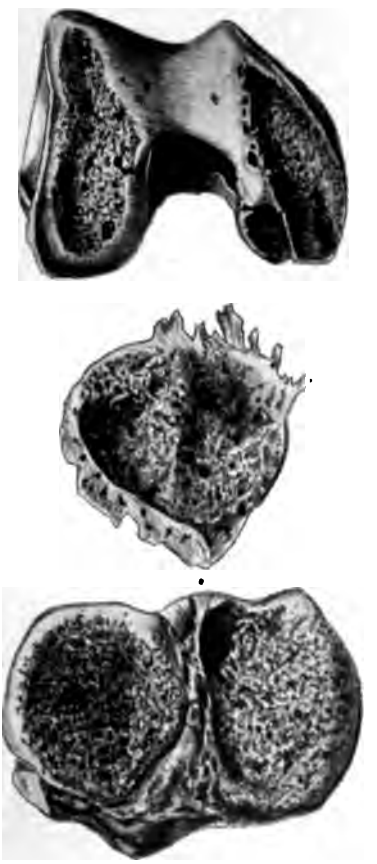


FIG. 237.—BONES ENTERING INTO FORMATION OF KNEE-JOINT, WHICH HAS BEEN DISORGANIZED BY TUBERCULOUS DISEASE. (FROM COLLEGE OF SURGEONS' MUSEUM.)

The cartilage is almost entirely destroyed, and the exposed bone is carious and eroded.

malaise. If they burst, temporary relief follows; but if the continues, and fresh abscesses form, septic phenomena a added to those already present. The patient develop temperature; amyloid degeneration of the viscera may s the limb becomes more and more deformed; abnormal n from relaxation of ligaments may exist, but these can demonstrated only under an anæsthetic; and finally the p hausted partly by the discharge, partly by the pain, and the want of sleep, becomes emaciated, and may even prompt measures are taken for his relief.

Results.—(*a*) If seen in the early stages, and suitably t disease may be entirely cured, and a moveable joint result. frequently the articular structures are so severely damag cure can only be established by means of ankylosis. Unles have been adopted to maintain the limb in a satisfactor permanent deformity may ensue. (*c*) If sepsis has been the patient will probably develop hectic or amyloid dis chronic toxæmia, and from this he may succumb. On hand, in a few instances he may survive such dangers, t alternately drying up and discharging, although he rema manent invalid, and the joint is crippled. (*d*) Acute mili culosis is occasionally met with as a complication of this whilst similar associated disease of the lungs, brain, kidney viscera, may be lighted up.

The **Prognosis** is mainly influenced by the condition dividual and his surroundings. In children of the bett where every hygienic and medical assistance can be given generally follows, unless there is a strong counterbalancing tendency. Amongst the poorer classes, and especially children,' the outlook is correspondingly serious. More extremes of life are unfavourable: babies resist tuberculo

PLATE XXIX.

Tuberculous Disease of Knee-Joint, showing Invasion of Patella

aggravates the trouble by providing increased pabulum for the micro-organisms.

3. *Abscesses* are, if possible, dealt with sufficiently early and in such a manner as to obviate the need for prolonged drainage. To this end they ought never to be left long enough to allow the skin and subcutaneous tissues to become involved, but as soon as a collection can be detected it should be tapped by a large trocar and cannula, the cavity well irrigated, and injected with iodoform emulsion. It is wise to incise the skin with a knife, and not to puncture it with the trocar; the irregular wound made by the latter does not heal quickly; a stitch closes the incision and assists satisfactory healing.

Of course, when the skin is reddened, and the pus subcutaneous, the abscess must be incised and drained in the usual manner, any thin and undermined skin being snipped away.

4. If hygienic treatment cannot be carried out satisfactorily, or if the disease progresses in spite of such measures, *operation* may be necessary. Two chief plans need consideration, viz., arthrectomy and excision; but it must be remembered that each joint presents peculiar features, and that considerations referable to one do not necessarily hold good for another.

Arthrectomy or erasion of the joint consists in laying open the cavity and removing all the diseased tissues that can be reached. The synovial membrane is scraped or cut away; diseased foci of bone are gouged out, and the resulting cavities disinfected by carbolic acid and packed with sterilized iodoform. Ankylosis is the usual, though not invariable, result. It is obvious that this proceeding is not equally applicable to all joints. Thus in the hip the opening is usually made from the front, and unless there is great laxity of the capsule and some increase in size of the acetabulum, the back and upper part of the joint cannot be reached. The knee, ankle, and elbow are perhaps the most favourable situations for this operation. The chief advantages over excision are that it interferes neither with the immediate length nor with the subsequent growth, whilst there are no extensive sections of bone which may become subsequently infected.

Excision of a joint is a more radical measure, but has the disadvantage of removing healthy as well as diseased tissues; whilst the fact that it may encroach in children on the epiphyseal structures renders it undesirable as a routine procedure. Increased confidence in conservative measures has rendered this operation much less common than formerly. The chief conditions for which it is now employed in tuberculous disease are as follows: (*a*) For complete disorganization of the joint, or when extensive bone mischief is present; (*b*) to prevent ankylosis in certain joints, such as the elbow and temporo-maxillary; (*c*) to determine a rapid and radical cure with synostosis in such a joint as the knee, as soon as it is evident that the natural result of the disease must be an ankylosed limb. Surgical art often produces a more efficient cure than Nature under these circumstances, since all foci can be removed. A natural cure often

leaves many tuberculous foci encapsuled, and these may subsequently cause pain and lead to recurrent attacks of inflammation. (*d*) Deformity with or without ankylosis may also need excision.

The choice of operation in any particular case is not always an easy matter, and before reaching a decision several factors must be taken into consideration: (i.) The *age* of the patient. As already mentioned, the fact that typical excisions encroach on the growing ends of bones renders them undesirable in children. Even if growth is not stopped thereby, it may be rendered irregular, and subsequent deformity may ensue. In the knee, however, it is possible to remove a thin slice of articular cartilage, so as to gain synostosis of the two epiphyses without interfering with the growth. As regards advanced age, opinions differ somewhat, but the shoulder and knee may be excised satisfactorily at a much greater age than the elbow, wrist, and ankle. Probably forty to forty-five years would be looked on as the age limit for the latter, but we have had excellent results from excising the knee and shoulder at a much later period of life. (ii.) The *general health and vitality* of the individual must be fairly good if either erasion or excision is to be undertaken. In weakly individuals amputation is often the better practice, as also when hectic fever is pronounced and amyloid disease of the viscera advanced. (iii.) The *extent* of the bone mischief. If this is slight, erasion may be undertaken; if more extensive, excision. But if the bone trouble is so exaggerated that the removal of the diseased tissue would leave a flail-like, useless limb, then amputation is required. (iv.) It is useless to attempt erasion where there is much invasion of the soft tissues; excision may even be impracticable under these circumstances, and amputation may be the only hope. (v.) Where septic sinuses are present, and especially if any subacute or acute sepsis exists, free incisions should be made to give relief to tension and allow the inflammatory disturbance to quiet down before any serious operative measures are considered.

5. *Amputation* is required in cases which, in spite of every care, are steadily going from bad to worse, and where the patient's health and strength are being sapped by the disease. It is also required not unfrequently in old people, and where the mischief in the bones and soft parts is very extensive. In addition, it is indicated in patients where excision has been undertaken and failed, either from the limb becoming subsequently flail-like or useless, or from recurrence owing to incomplete eradication, or from the advent of sepsis. Lastly, if the disease is present in two joints at one time, or in a joint and some other organ, neither of which is improving, total removal of one focus of mischief will often induce a rapidly favourable change in the other.

Tuberculous Disease of Special Joints.

The **shoulder-joint** is but rarely affected in children, and not very commonly in adults. The disease usually starts in the head of the humerus, affecting subsequently the synovial membrane, and perhaps also the glenoid cavity. If abscesses form, they are likely to point

either in front of or behind the deltoid, in the former case extending along the synovial membrane lining the bicipital groove. Pathological dislocation of the head of the bone forwards and upwards may occur at a late stage, somewhat resembling an unreduced subcoracoid dislocation. In the traumatic variety, however, the fixity is greatest at first, and the movements subsequently improve; in the tuberculous form, the limitation of movement gradually increases until complete ankylosis supervenes. Excision of the head of the bone is almost always required in order to effect a cure.

In the **Elbow** the disease is most common in young adults, and is often primarily osseous, commencing in the olecranon or outer condyle of the humerus. In children the synovial membrane is first affected, frequently starting in the superior radio-ulnar articulation. The swollen synovial membrane bulges on either side of the olecranon and tendon of the biceps, and can often be felt over the head of the radius. Sinuses form by the side of the olecranon, or an abscess may burrow upwards along the ulnar nerve and open on the inner aspect of the arm. Prolonged immobilization, followed, if need be, by incision and partial removal of the synovial membrane, often suffices in children, leaving, however, a stiff elbow, which must be left alone until growth is completed. In adults excision is the correct practice, and the results are very satisfactory, provided that a sufficient amount of bone is removed, and the muscular attachments are interfered with as little as possible. If expectant treatment is adopted, the arm should be flexed to a right angle, and with the hand midway between pronation and supination, so that, if ankylosis follows, the limb may be in the most useful position. Arthrectomy is occasionally adopted, and is best accomplished by means of an H-shaped incision over the olecranon, which process of bone is divided at its base and turned upwards, so as to expose thoroughly the interior of the articulation. After removing all diseased tissue, the olecranon is replaced and wired to the shaft of the ulna.

In the **Wrist** diffuse disease of the synovial membrane and bones is met with, starting most frequently from the former structure; if primarily osseous, it usually commences in the lower end of the radius. It may also extend from a tuberculous affection of the adjacent tendon sheaths. A characteristic doughy swelling forms over the dorsum, displacing the extensor tendons, whilst the palmar aspect of the wrist is also puffy. Sinuses develop most frequently on the dorsal aspect or by the side of the flexor carpi radialis tendon. Conservative measures may bring about a cure, and every effort should be made to avoid excision, since the result of this proceeding is almost always the production of a weak and flail-like hand, so that the constant use of a leather support is essential after healing has occurred. In elderly people amputation is often the only resource.

Diseases of the **Hip-joint** and of the **Sacro-iliac Articulation** are separately considered (pp. 685 and 694).

The **Knee-joint** is, perhaps, more often affected with tuberculous disease than any other articulation. It appears to start in the synovial

ıne or bone with almost equal frequency; if the bones are first , the primary focus is usually situated on the inner aspect of he femur or tibia. Sequestra are found in nearly one-half of s in which the bone is affected, becoming more frequent as advances. The disease runs a typical course, and needs no comment. When the joint has become disorganized, the tibia to be displaced horizontally backwards, flexed and externally and ankylosis in this position is difficult dy, even by operation.

nged immobilization on a back-splint, or ly the application of a Thomas's knee- Fig. 238), so that the patient can walk ı the fresh air, together with iodoform in- and constitutional treatment, will be l in many cases. Failing this, a modified omy may be undertaken in children where is still progressing, and to carry it out an should be made across the front of the m condyle to condyle, as for an excision, ; either the ligamentum patellæ, or perhaps lla, which is subsequently wired together. bole of the synovial membrane is then d away, special attention being directed ubcrureal pouch and the back of the joint. slice should be removed from the surfaces tibia and femur, and if the epiphyseal es are not encroached upon, the growth of b is not impaired to any great extent, h it may become irregular and lead to leformity, *e.g.*, well-marked flexion, or curvatum(p. 440). In adults, where the ıre not too extensively involved, so that ion broad healthy surfaces can be apposed, ı is a most satisfactory operation, provided, se, that the synovial disease is also removed. As soon as it s evident that the only possible natural cure is by ankylosis, and dence would be given by fixation of the patella to the femur, severe starting pains at night, excision is justifiable and le. It cuts short the disease, and provides a quicker and adical cure than Nature can possibly effect. Incomplete l of the disease, either in the synovial membrane or bone, etermine recurrence; if this cannot be dealt with effectively, ation may be required, and then a long posterior flap is the ealthy tissue available for covering the bone. Under other ıstances the supracondyloid amputation can be adopted.

FIG. 238. THOMAS'S KNEE-SPLINT APPLIED.

Ankle-joint.—Tuberculous disease of this joint usually com- s in the synovial membrane rather than in the bone. If rily osseous, the astragalus is more frequently affected than the end of the tibia. The whole region becomes occupied by a

owing to the fact that, when once the astragalus is ne
tuberculous process is likely to spread to the articulati
beneath it, and so to the other bones of the foot. Wh
any doubt as to the condition of the astragalus, that bone
removed at the same time as the lower ends of the tibia
Where the disease is more extensive, a supramalleolar s
of the foot will be necessary.

For diseases of the **Bones and Joints of the Foot, see p.**

Syphilitic Diseases of Joints.

Although syphilitic disease of joints is rare in propor
prevalence of syphilis, yet several varieties have been di
and recognised. (1) In the later stage of the secondar
chronic form of *synovitis* occurs, evidenced by passive effusi
joint, with or without pain, and usually persisting for s
Any joint may be attacked in this way, perhaps the
commonly, and the affection is often symmetrical in its di
The effusion may be only slight, but is frequently very co
(hydrarthrosis), and a marked feature in the condition com
rapid variations in the amount of swelling, even from day t
some few cases this affection resists all treatment, an
ultimate disorganization. (2) Gummatous inflammation
synovial fibrous tissue, which may or may not extend to th
bone, is met with in the tertiary period. It either ap
localized hard nodule, resembling in measure a fibrous tu
then causing but little trouble beyond a sense of painful w
the articulation; or it is more diffuse in its distribution, l
moderate effusion, and later on to much thickening and
of the capsular and other ligaments, and resulting in co
impairment of its movements from cicatricial contraction,

and proliferation of the cells. The cartilage softens, and becomes eroded by friction of the articular surfaces. The bone thus exposed is worn away, and curiously 'pitted' and excavated. It is recognised from osteo-arthritis by the facts that there is usually but little or no pain; that the eburnation of the exposed bone is less extensive, and therefore crepitus is but little marked; whilst the typical osteophytic growths, causing 'lipping' of the joint margins, are absent. The eroded areas, moreover, do not correspond with the sites of intra-articular pressure, and are more rounded and punched out, and not arranged in linear grooves, as in the latter disease. It is not uncommonly associated with a gummatous thickening of the synovial membrane, and, indeed, the hollows or pits above mentioned may be filled with caseous material, derived from degeneration of this tissue.

The **Treatment** in the early manifestation consists in the administration of mercury, and the judicious application of pressure with or without immobilization, according to the requirements of the case and the joint affected. In the tertiary forms iodide of potassium in gradually increasing doses has a rapidly beneficial action, which confirms the diagnosis; it may be occasionally combined with a small amount of mercury, either given internally, or applied locally if any ulcerative lesion exists. In the most pronounced cases, where the pain is severe and disorganization of the joint has occurred, excision may be necessary, and the results are often very satisfactory.

Osteo-arthritis.

Although this disease is extremely common in this country and has well-marked characteristics, its nature is still obscure, as is evident from the number of names applied to it, such as *chronic rheumatoid arthritis*, *rheumatic gout*, *arthritis deformans*, *arthritis senilis*, *arthritis sicca*, etc. There is not the slightest doubt that several types of disease have been confounded together under this title, and although at the present time it is admitted that rheumatic and gouty conditions are to be excluded, yet it is probable that we are still including more than one type of chronic articular trouble.

Ætiology.—Exposure to damp and cold is doubtless an important factor in the production of osteo-arthritis, especially in elderly people, or when some depressed condition of the nervous system is superadded, whether such be due to worry, anxiety, or to defective nutrition. In other cases where there is no question of exposure, the affection is by some attributed to nervous influences (Senator, Ord), and particularly to affections of the uterus and ovaries, which it is supposed are capable of inducing reflex changes in the joints. Others, again, attribute it to auto-intoxication due to indigestion of duodenal origin. Recently a theory of bacterial causation has been propounded, and although it cannot be considered as proven, yet evidence in favour of its probability is steadily accumulating. It is supposed that the organisms find their way into the joints from some other focus of infection, and in this connection it is interesting to note the statement

that in a large series of cases 55 per cent. were precede other infective fever or disease (Bannatyne). They deve joints, and produce toxic bodies which act locally by destructive phenomena of a special type, whilst by the absorption various trophic and nervous symptoms are cau existence has been constantly noted, but for which hith had been no adequate explanation. Such an origin will al the presence of enlarged glands in the neighbourhood of s affected joints (Still). Several observers have found bacte the joints, and Bannatyne and others have described a shor the ends of which stain dee the intervening portion re stained, causing it to lo diplococcus.

FIG. 239.—PATELLA FROM EARLY CASE OF OSTEO-ARTHRITIS, SHOWING FIBRILLATION OF CARTILAGE. (HOWARD MARSH.)

Traumatism plays an i part in the production c types of osteo-arthritis, an emphatic in maintaining t cases should be relegated t ent category, and be known *traumatic arthritis;* the char ever, are so similar to thos arthritis that we prefer to it a subdivision or varie injury may be slight in na as a sprain or strain, or mo such as a fracture or dislo volving the articular surfa it is not uncommon to see ing Colles's fracture or o cervix femoris. Abnormal pressure maintained for a long causes changes of a similar type, and thus many of the labouring men are deformed in a peculiar fashion, accordi special type of work and the particular joints that are e strain. Senile degeneration also seems to produce articul of a very similar character.

Pathological Anatomy.—The disease commences in the cartilage, the matrix of which cracks and undergoes fibrillar and presents a villous appearance, resembling the pile (Fig. 239). The cartilage cells proliferate, so that the contain many instead of one, and these, giving way, disch contents into the joint. The cartilage thus softened is rea away by the movements of the articulation, and the expose of bone becomes hard, sclerosed, and polished like ivory (et This usually occurs in certain definite directions. In hin the surfaces become grooved longitudinally, whereas in socket joints, like the hip, the head is eroded in a circular This condensed tissue does not extend very deeply, and imi beneath it the cancellous bone is of a more open texture th

and filled with fatty medulla. In spite of the sclerosis, the articular end of the bone is continually being worn away, and this may go on to such an extent as to lead to actual shortening of the limb. Concurrently with this destruction, new bone formation is taking place at the margins of the articular cartilage, producing irregular osteophytes, which have been likened to the gutterings of a candle. They are preceded by an overgrowth of cartilage, in which ossification takes place secondarily. When such outgrowths have been produced more or less evenly around the joint margin, a characteristic 'lipping' of the edge of the cartilage results (Fig. 240). Sometimes these osteophytes attain to a large size, and by interlocking may lead to ankylosis of the joint. The synovial membrane is usually thickened, and the villi occasionally proliferate, and may reach such dimensions as to be felt through the skin, rolling under the finger. They are red, vascular, and succulent during life, but after removal and preservation in spirit, they look shrunken and insignificant. This overgrowth is often associated with excessive effusion, though usually the affection is of a dry type. Occasionally cartilaginous nodules develop in the villi of the synovial fringes, later on becoming ossified, and if detached constitute one form of loose cartilage.

FIG. 240.—LATE STAGE OF OSTEO-ARTHRITIS OF KNEE, SHOWING DESTRUCTION OF THE ARTICULAR CARTILAGE, AND EBURNATION OF THE EXPOSED BONE IN LONGITUDINAL GROOVES. (FROM COLLEGE OF SURGEONS' MUSEUM.)
The margins of the surfaces are distinctly lipped.

Clinical History.—Three chief types of this disease may be described:

1. The *chronic monarticular variety* is that most frequently seen by surgeons, and is constantly brought about by injury. Pain and creaking of the joint on movement are the early symptoms of this affection. There may be very little swelling, unless effusion is present, but pain, especially at night, is most troublesome, being usually increased on changes of weather, particularly if rain is threatening. The pain and stiffness are most marked after keeping the parts at rest, and diminish when the limb is used. As the disease progresses, the movements become more and more impaired, and the crepitus

more of an osseous type; the ends of the bones are felt enlarged lipped, and deformity soon becomes obvious. Exacerbations in symptoms occur from time to time, resulting in increased cripp of the articulation. Finally, the limb may become absolutely usel partly from the pain and partly from the limitation of movem produced by the osteophytes. Wasting of the adjacent muscle also a marked feature.

It is usually seen in elderly people, and may supervene very quic after an accident, such as fracture or bruising of the cervix femo and then the destructive phenomena may progress at a rapid r When it appears in younger people, the osseous lesions are much l evident.

2. The *chronic polyarticular variety* arises independently of r matism, and is most commonly seen in females of middle life. may commence in one joint and spread to others, or it may ap in many joints simultaneously. Most frequently one or more of phalangeal articulations is the starting-point, particularly the term ones. The joints become stiff and swollen, are tender, and so nodular bony outgrowths develop at the bases of the phalan which are known as Heberden's nodosities. The trouble gradu spreads to other joints, and although there are often remissions, the condition progresses steadily until the patient may be entir crippled thereby. Well-marked overgrowth of bone and eburnati of the articular ends are characteristic features of this type. Som times there is considerable effusion, accompanied by overgrowth the synovial villi, but this is unusual.

3. The *acute polyarticular variety* does not often come to the surge for treatment, at any rate in the early stages. It usually attac young or comparatively young people, and females rather th males, frequently following some infective trouble, such as influen scarlatina, tonsillitis, etc. It is often ushered in by a distinct febr attack with persistent increase in the rate of the heart-beat; troph and vasomotor phenomena are often co-existent, such as patches pigmentation, clammy cold hands, and rapid muscular atrophy. T smaller joints of the hands and feet are mainly affected, and that mo or less symmetrically, although the terminal inter-phalangeal articu tions often escape. The capsules are distended with a certain amou of effusion, causing the joints to look spindle-shaped, and at first th is but little osseous mischief. In not a few cases a very characteri deformity in the shape of ulnar adduction of all the fingers occu Gradually the trouble spreads to other and larger joints, and osseo manifestations appear; but the progress is slow, and may be to large extent arrested by treatment. Neighbouring lymphatic gla may be enlarged in the early stages.

It is important to note that gouty and rheumatic troubles may associated with osteo-arthritis: the rheumatic affections may precede the gouty usually follow.

The **Diagnosis** of osteo-arthritis *per se* is not often difficult in a we marked case, the crepitus, pain, and enlargement of the ends of t

. For diagnosis from *chronic rheumatism* and *Charcot's disease*, 657 and 678.

diagnostic points between polyarticular osteo-arthritis and *gout* ggested in the following table:

	Osteo-arthritis.	Gout.
	Females:	Males:
f patient.	Poor, ill-nourished, depressed, anxious; often exposed to damp and cold	Well-to-do and well-nourished people.
	Insidious.	Sudden and obvious.
of onset.	Usually in hands, especially in the thumb.	Feet, especially metatarso-phalangeal joint of great toe.
attack.	No obvious swelling or redness.	Red and painful at first, with skin shiny over the joint.
	Slight and aching.	Severe and acute.
try.	Well marked.	Not usually present.
of urate of	Absent.	Present.

Prognosis is usually unfavourable. The fact that many joints cted is an indication that there is a considerable constitutional cy to the development of the disease, and although it may be arily combated with success, still, sooner or later, the patient st certain to be crippled by it. The affection of only one joint oints to a traumatic origin, and the outlook is correspondingly r; but where the disease attacks several parts of the body, s but little hope of checking it, and indeed cases are known in every joint has successively become implicated, the patient g on a weary existence, never free from pain, and usually in ped or sitting posture, until death from exhaustion supervenes.

tment.—For this troublesome complaint there is, unfortu-

is desirable. As to general treatment, the individual is warned against exposing himself to cold and damp, and, since the disease is often considered to be due to perverted or diminished nervous activity, all possible sources of irritation and worry should be removed. At the same time the nutrition must be improved, and plenty of good food, cod-liver oil, etc., administered. A large number of different drugs have been tried for this complaint, but none of them are very satisfactory. Perhaps the best is iodide of sodium combined with some alkaline purgative and hepatic stimulant, such as sulphate of soda. Natural mineral waters and baths are often beneficial, those of Bath and Buxton in this country being most frequently recommended. Arsenic is sometimes useful in cases where the disease is probably of nervous origin.

Occasionally operative treatment in the shape of *excision* may be useful in this complaint, but only when the disease is limited to one joint, and when it has progressed to such a stage as seriously to cripple the patient's usefulness, as in the knee-joint, elbow, or the shoulder, or when the act of mastication is impaired, owing to an affection of the temporo-maxillary articulation. In suitable cases excellent results are obtained.

The *hip-joint* is not uncommonly the seat of osteo-arthritis in old people, and it always causes a considerable amount of pain, especially on flexion of the limb, rendering sitting difficult and walking uncomfortable, whilst the movements are steadily more and more curtailed. The limb appears at first to be slightly increased in length, but later on becomes shortened from erosion of the head and atrophy of the neck of the bone; the trochanter is also much thickened and more prominent than usual, on account of the associated atrophy of neighbouring muscles. Well-marked crepitus is obtained on moving the thigh. The acetabular cavity is increased in size owing to the formation of a projecting rim or lip. If a patient falls on the affected hip, some difficulty may be experienced in making a diagnosis from fracture of the neck of the thigh-bone. The previous history and the facts that the trochanter rotates around its normal centre, and is unduly prominent rather than approximated to the median line, and that the ilio-tibial band is not relaxed, as in fractures, should suffice to prevent mistakes.

When the *temporo-maxillary joint* is affected, the condyle of the jaw becomes larger than usual and somewhat flattened, whilst the eminentia articularis is partially absorbed and the glenoid cavity increased in size, so that there is a tendency for the condyle to slip forwards owing to the action of the external pterygoid muscles. If only one joint is affected, the bone is carried towards the sound side, but when both are involved the chin becomes prominent owing to a forward displacement of the whole bone. Pain and crepitus are experienced on opening the mouth, rendering mastication difficult, and even impracticable. If ordinary treatment fails to give relief, the affected condyle of the jaw should be excised.

For osteo-arthritis of the *Spine*, see Chapter XXIV.

Neuropathic Arthritis (*Syn.:* **Charcot's Disease.**)

This disease, bearing the name of the late Professor Charcot, is a peculiar affection of joints met with in the course of locomotor ataxy. It is slightly more common in women than men, and is almost always an early manifestation, occurring usually between the lightning-like pains and the onset of the ataxic symptoms. The most typical form is lighted up by some slight injury—*e.g.*, a strain or sprain—and is

FIG. 241.—HYPERTROPHIC VARIETY OF CHARCOT'S DISEASE OF KNEE-JOINT. (FROM COLLEGE OF SURGEONS' MUSEUM.)

The patella (PAT.) can be seen poised on the top of a mass of new bone formed by the welding together of a number of smaller portions formed in the peri-synovial tissues.

FIG. 242.—ATROPHIC VARIETY OF CHARCOT'S DISEASE OF KNEE-JOINT. (FROM COLLEGE OF SURGEONS' MUSEUM.)

The bones are cleanly eroded, and no new formation is present. The patella is reduced to a mere shell, one-eighth of an inch thick.

characterized by a rapid painless distension of the joint with a light-coloured serum, which may also extend into the communicating bursæ; there is some amount of effusion into the surrounding cellular tissue, although without œdema. This distension may be so rapid that abnormal mobility or even dislocation may occur at the end of a few hours. The joints most frequently affected are the knee, hip, and shoulder; occasionally more than one articulation is involved. The course of the case varies; in some few instances the fluid is gradually absorbed and the joint returns to its normal size and shape,

although somewhat weakened. Sometimes the attacks of di recur, and after each the joint becomes more and more cripp others, however, and perhaps most frequently, the bones eroded to a considerable extent, the ligaments stretched, and flail-like articulation remains, in which the ends of the bo atrophied and displaced (Figs. 242 and 243). In other in new osseous formations occur here and there under the membrane, especially in cases where there is much disten that on compressing the swelling between the hands a s is produced similar to that imparted by grasping a bag o Occasionally, under these circumstances, the osseous masses welded together, giving rise to large overgrowths, which le sequently to fixation of the joint (Fig. 241). The disease so runs a more chronic course, and then closely resembles osteo-a since there is but little effusion, whilst the ends of the bones

FIG. 243.—CHARCOT'S DISEASE OF LEFT KNEE AND SHOULDE
The great atrophy of the ends of the bones, and the resulting dislocati clearly evident.

eroded, and osteophytes, perhaps of great size, form aro edges of the cartilages, leading to defective mobility and cre

The **Diagnosis** of Charcot's disease from *osteo-arthritis* is, a readily made if one remembers the following points: C disease is usually characterized by a rapid onset, limitatio joint, considerable effusion, absence of pain, atrophy of the the bones, and a tendency to the production of a weak, joint, whilst the general signs of tabes are also observed. arthritis, on the other hand, comes on slowly, often affec joints, has but little effusion, is very painful, and is attend overgrowth tending to produce ankylosis. In the more chro the distinguishing features are much less evident.

As to pathological anatomy, the changes observed are pr identical with those seen in osteo-arthritis, except that the e more rapid, the effusion greater, and the formation of oste less constant.

The **Treatment** of Charcot's disease consists in keeping the

rest on a splint and applying elastic pressure. The effusion, when considerable, may be removed by an aspirator, but is very likely to re-collect. In the later stages, where the joint is entirely disorganized, some form of fixed apparatus may be applied to render the limb more useful, or, failing that, amputation may be required.

The same type of articular lesion occurs in *Syringomyelia*, a disease which consists in a gliomatous development in the spinal cord, and usually in the cervico-dorsal region. It is characterized by loss of the senses of pain, and of heat or cold, but tactile and muscular sensibility persists. Atrophy of various muscles of the hand or fore-arm also occurs, whilst trophic lesions, *e.g.*, whitlow, perforating ulcer, etc., are common. Joint troubles are observed in at least one-third of the cases, mainly in the upper extremity, tabes generally affecting the lower. Either atrophic or hypertrophic phenomena are developed, and the course is identical with that of Charcot's disease, except that suppuration is a little more likely to follow, owing to the frequent presence of septic sores.

Somewhat similar in nature to Charcot's disease is the chronic arthritis met with in many conditions where the nervous supply to a limb is impaired as a result of central or peripheral disease of the nervous system. Thus, it may follow spina bifida, hemi- or para-plegia of cerebral or spinal origin, or may be secondary to a peripheral neuritis, due to either injury, syphilis, gout, diabetes, leprosy, etc. The terminal articulations of fingers or toes are those most often affected (acro-arthritis), although larger joints may be involved. They become swollen and painful, and after a time ankylosis ensues.

Hæmophilic Diseases of Joints

In hæmophilia (p. 292) any injury to a joint, such as a sprain or wrench, may lead to a copious effusion of blood into the articular cavity, which becomes suddenly swollen, distended, and evidently full of fluid. There is some pain on movement, the part becoming hot and tender, whilst when coagulation has taken place it is hard and firm. Total recovery may ensue, or the joint be left weak and liable to recurrence of hæmorrhage and inflammation. The effects on the articular surfaces are curious: the cartilages usually retain their normal colour, but become thin, worn, and rough, especially at the points of greatest pressure; fibrillar degeneration of the matrix may occur, and in some cases the cartilage has been found totally absent, being replaced by fibrous tissue. Ecchondroses subsequently developing into bone are formed at the margins of the joint surfaces, the changes thus produced being somewhat akin to those of osteo-arthritis. The ligaments and synovial membranes may remain of a normal texture, or are slightly thickened, and usually of a russet-brown colour. Adhesions are often present, causing considerable impairment of mobility. The *Treatment* consists in keeping the part at rest, and applying ice in the early stages; whilst, later on, friction, massage, and pressure may be employed. The surgeon must never attempt to aspirate the joint, even with a fine needle.

Loose Bodies in Joints.

Several varieties of loose bodies are met with in joints, which may be described as follows: (1) The so-called 'melon-seed bodies' consist of fibrin derived from altered blood-clot, or more frequently from a

fibrinous exudation in cases of very chronic tuberculous disease. At first irregular in shape and laminated in texture, they are gene[illegible]ally transformed into round or flattened pellets or elongated masses by the movements of the articulation. Bursæ and tendon sheaths are much more frequently affected than joints. The number present is usu[illegible]ally considerable, whilst there is also some glairy effusion, causing distension and a certain amount of creaking. A few years ago we operated on a case in which the knee-joint was occupied by a num[illegible]ber of rounded yellowish-white foreign bodies, several of which were nearly as large as walnuts; they were probably of hæmorrhagic ori[illegible]gin.

2) Portions of articular or inter-articular cartilage may be broken off as a result of mechanical violen[illegible]ce. They usually consist of a smo[illegible]oth rounded mass of articular ca[illegible]rti-lage enclosing a central bo[illegible]ony nucleus (Fig. 244). (3) Th[illegible]ey are sometimes derived from t[illegible]he development of cartilagino[illegible]us nodules in the synovial fring[illegible]es or villi, which may either rema[illegible]in adherent and become pedun[illegible]u-lated, then occasionally weari[illegible]ng a bed for themselves in the a[illegible]rti-cular surface, or may be tota[illegible]lly detached. Such structures are usually lobulated and irregular in shape, and consist of calcifi[illegible]ed cartilage or bone, whilst a certain amount of normal cartilage is also present (Fig. 245). This condition may result from oste[illegible]o-arthritis, but sometimes the cartilaginous cells from which they are derived have persisted as a 'fœtal residue.' (4) Finally, portions of bone may become separated from their surroundings, and remain loose in the cavity. Thus, ecchondroses may be broken off in cases of osteo-arthritis, or portions of the articular surface detached by mechanical means, or even sclerosed areas isolated by a process of rarefying osteitis without suppuration, constituting what Paget originally described as 'quiet necrosis.'

FIG. 244.—FOREIGN BODY IN JOINT, PROBABLY DERIVED FROM A PORTION OF ARTICULAR CARTILAGE. (FROM COLLEGE OF SURGEONS' MUSEUM.)

A, cartilage; B, bone.

Although cut off from all vascular supply, the growth of some of these loose bodies is said to continue, owing to the highly nutritious fluid which bathes their surfaces.

The **Symptoms** caused by this condition are produced by the loose body being occasionally caught between the articular surfaces, leading to a temporary locking of the joint and severe pain, owing to the stretching of the ligaments. The fixation is but momentary, since the foreign body is readily displaced, but an attack of subacute synovitis follows. When this has happened several times, the ligaments are likely to become relaxed, and the joint somewhat loose and distended. Under such circumstances it may be possible to feel the foreign body and to shift its position, but frequently the surgeon, owing to its ready mobility, is unable to detect the intruder as it slips

away into the interior of the joint. From this point of view, the German term 'Gelenkmaus' (joint mouse), as applied to this affection, is most happy. The knee-joint is that most frequently affected, but the same condition occurs in the elbow and temporo-maxillary articulation.

The **Diagnosis** between a loose body and a *displaced semilunar cartilage* in the knee-joint is not always easy, since in both conditions painful locking of the joint occurs. The fixation, however, is but momentary in the case of a loose body, but may persist until reduced in the latter, whilst a localized spot of tenderness may be detected corresponding to the site of the injury to the inter-articular cartilage. Moreover, the history of the case is very different, since the dislocation of a semilunar cartilage is always primarily referred to some twist or sprain of the joint, whereas with a loose body no such traumatic influence need be present.

FIG. 245.—LOOSE CARTILAGE IN JOINT, PROBABLY DEVELOPED IN A FRINGE OF SYNOVIAL MEMBRANE. (FROM COLLEGE OF SURGEONS' MUSEUM.)

A, cartilage; B, bone.

The **Treatment** consists in the removal of the foreign body by an open operation. In the knee-joint a vertical incision should be made, about 2 inches in length, extending a little above and below the line of the articulation. It should be placed about 1 inch from the patella, on whichever side the loose cartilage presents most frequently, but preferably on the outer. If possible, the foreign body should be fixed by the finger in one of the lateral pouches of the joint before making the incision. The capsule and synovial membrane are opened, the loose body removed, and the cavity washed out, if thought desirable, with sterilized saline solution. The wounds in the synovial membrane, capsule, and skin are then carefully sutured. The joint should be kept at rest subsequently for two or three weeks, and an elastic knee-cap worn for some time.

Neuralgic Joints.

In neurotic individuals, especially young women, a neuralgic condition of the joints is commonly met with, simulating disease of the articulation. On careful examination the pain is found to be super-

ficial, not increased by jarring the articular surfaces together, and often not strictly confined to the joint. The movements are apparently limited, but if the attention of the individual is diverted, or anæsthesia induced, they are found to be perfectly free. There are no signs of effusion into the cavity, and no starting pains at night. Occasionally a similar condition is met with in men, where there is no suspicion of hysteria.

The *treatment* is constitutional and local. The former is directed towards improving the general health, and correcting any error in the uterine functions. The latter is best accomplished by the use of cold douches and electricity, although counter-irritation in the shape of blisters, or even the actual cautery, has an excellent moral effect.

Ankylosis.

By ankylosis is meant a condition of immobility, partial or complete, of a joint, resulting from some preceding inflammation of the articular structures

The term *false* ankylosis is sometimes applied to a condition resulting from extra-articular lesions. Such may be either fibrous or osseous, and is due to cicatricial contraction of the skin, shortening of muscles, or even to the development of bony tissue within them (*myositis ossificans*). *True* ankylosis always involves the articular structures, and is either fibrous or bony.

Fibrous or incomplete ankylosis results (*a*) from thickening and contraction of the ligaments, such as often occurs after gonorrhœal or rheumatic affections; (*b*) from the formation of cord- or band-like adhesions within the joint, after acute synovitis; (*c*) from erosion of the cartilage and exposure of the bone; granulations sprout up on each side, and by their union lead to dense fibroid adhesions between the articular surfaces. Some amount of movement is possible in most of these cases.

Complete or osseous ankylosis (synostosis) arises from the union of either the whole or part of the opposing surfaces left by the destruction of the cartilage, the bond of union, at first fibro cicatricial, being subsequently ossified (Fig. 246); it may also be due to the interlocking and fusion of osteophytes, formed at the margin of the bone in osteo-arthritis or Charcot's disease.

The **Causes** of ankylosis are very variable, but may be arranged as follows:

1. Injury to the articular surfaces, as from fractures which run into a joint.

2. Non-suppurative inflammations of joints, involving the formation of fibrous adhesions or the contraction of ligaments, as in synovitis, whether traumatic, rheumatic, gouty, gonorrhœal, etc., and the early stages of acute or tuberculous arthritis.

3. Destruction of bones, associated or not with articular diseases, as in Pott's disease of the spine, and the later suppurating stages of acute or tuberculous arthritis.

s affections are occasionally the cause of ankylosis, o a chronic form of arthritis. The lesions may be spina bifida, tabes, and syringomyelia; or peripheral, s, Raynaud's disease, diabetes, leprosy, or division of

ntinued abnormal pressure of contiguous bones may rlosis, as in scoliosis or osteo-arthritis of the spine. In ection the immobility may to ossification of ligaments rlocking of osteophytes. n in which ankylosis occurs s thus produced differ ac- e joint affected.

Fig. 246. Ankylosis of Hip-joint in Good Position after Early Hip Disease. (Howard Marsh.)

lder there is but little dis- id the existence of immo- omparatively little impor- to the free movements of and clavicle. The deltoid ally much atrophied. The very commonly ankylosed f its exposed position, and y of fracture-dislocations ourhood. The formation ing up the olecranon and æ, and the adhesions likely n the joint in these cases, n its frequency. The most sition for ankylosis is when xed to a little more than a with the hand midway be- on and supination. By this to the mouth is possible, nt can use his hand for feeding purposes. The *wrist* is ly fixed as a result of gonorrhœal or rheumatic synovitis. *nt* (Fig. 246) much depends upon the treatment as to ankylosis takes place in a good or bad position. In es the thigh may be in a position of adduction and tion, crossing in front of the other leg. Occasionally *leformity* has resulted from inflammation of both hip- g lying in front of the other; progression is accomplished y, the body twisting at each step, and crutches are often the *knee-joint* ankylosis in an absolutely straight position should be aimed at, unless complete synostosis is likely en a slight degree of flexion may render the leg more In the *ankle-joint* considerable trouble may arise from nless the foot is at right angles to the leg.

—*Fibrous* ankylosis, due to massive adhesions, is often e, since even if the adhesions are ruptured by manipula- almost certain to re-form. Moreover, in an old-standing

case marked atrophy of bone is often present, and a fracture easily be produced. The existence of deformity, however, justi the employment of a certain amount of force in order to straigh the limb. If due to tuberculous disease, the possibility of lighti up the old mischief or disseminating the virus must be kept in mi and the haphazard methods of unscientific bone-setters in such ca have often been followed by disastrous results.

For *osseous* ankylosis various operative measures may be employ with a view either to correct the deformity, or in other cases restore movement to the part. At the *shoulder, wrist, and ankle* noth need be undertaken unless obvious and troublesome deformity present. At the *elbow* excision may be beneficially employed, a with every prospect of gaining a moveable joint. If, howev ankylosis is present in a child, the operation should be deferred u growth has come to an end. Ankylosis of the *knee* in a false positi needs cuneiform osteotomy, or the resection of a wedge-shaped port of bone, in order to secure a straight, rigid and useful limb.

Ankylosis of the *hip-joint* in a bad position is best treated dividing the neck or the upper part of the shaft of the femur. Seve operations have been devised for this purpose. 1. Adams' subc taneous osteotomy of the neck of the bone consists in passing sharp-pointed bistoury down to the anterior surface of the cerv femoris, from a point midway between the trochanter and the anteri superior spine of the ilium. A track is thus made, allowing th introduction of an Adams' osteotomy saw, by means of which th neck of the femur is divided subcutaneously. The limb is put up i a straight position, and the bone allowed to re-unite. 2. The sam result may be obtained by an open method, making the same incisio as in the anterior operation for excising the joint (p. 699). 3. Gu suggested division below the lesser trochanter. This may be accom plished by cutting down on the bone from the outer side and chiselli it across.

As to the operation to select in any particular case, the surgeon choice must be guided by the condition of affairs present. skiagram of the neck of the femur should always be taken, so as ascertain its condition. Sometimes it is stunted, and has practica disappeared; in other cases it is much thickened, and forms a lar bony mass passing from the trochanter to the ilium, and probab containing encapsuled foci of tuberculous material. In both the conditions subtrochanteric osteotomy must be employed, but prefe ably in an oblique and not a transverse axis; it is not unusual to fi that the adductor muscles are so contracted that their attachmen to the pubes require section before the limb can be satisfactor straightened. Division of the cervix can only be recommended wh that structure is of normal length and size.

Hip-joint Disease.

the term 'hip-joint disease' is usually applied to a arthritis, it is not the only affection involving this articula- e synovitis occurs in the course of rheumatic, gonorrhœal, affections. Acute arthritis is also met with secondary to ective osteo-myelitis of the upper end of the femur, and d by all the ordinary signs of that affection, separation s of the upper epi- g a frequent result. itis is not uncom-), whilst Charcot's r also occur; but se call for special e.

us Disease of the : Morbus Coxæ, Coxitis, Coxalgia)

) respect from the ise as it affects s, and hence no ice of the patho- tomy is required. ɔ say that it may in the synovial ɔr bone, more fre- he latter, and then g either beneath ır cartilage or in vith the epiphyseal the caput femoris

Very rarely the ecomes circum- the neck of the

FIG. 247.—TUBERCULOUS DISEASE OF THE HEAD AND NECK OF THE FEMUR, SHOWING SEQUESTRA IN AN ABSCESS CAVITY, AND COMMUNICATION ON THE UNDER SIDE OF THE NECK WITH THE JOINT. (TILLMANNS.)

The epiphysis of the head has been invaded, and the articular cartilage entirely stripped off by the disease; the continuous black line indicates the amount of bone which it would be necessary to remove.

ıg a chronic abscess, the diagnosis of which is exceedingly fore usually the disease spreads to the under side of the hus involves the synovial membrane, which passes into ɔulpy degeneration. The substance of the epiphysis is d caries of the head is thereby produced, together with ulceration of the cartilage. The acetabulum undergoes nges; from the contact and backward pressure of the ad the posterior acetabular margin is absorbed and the ıded, whilst at the same time a new rim of bone forms ɜ adjacent periosteum at a slightly higher level, thus ɔ what is known as a 'travelling acetabulum' (Fig. 248). the socket is increased both in size and depth, travelling and upwards with the head of the bone towards the

Other factors assisting in the displacement of the head are: the tonic action of the muscles, keeping the limb

in a position of flexion, adduction, and inversion, theret a considerable portion of the head to project out of the ac and the early softening and destruction of the posterior which are much thinner than those in front of the joint. Oc a mass of protuberant granulations sprouts up from the ce cavity, and may also assist in this process. Should the a be perforated, a tuberculous abscess is likely to form pelvis. The adjacent pelvic bones may either become thi

FIG. 248. — FEMUR AND ACETABULUM IN HIP DISEASE. (KING'S COLLEGE HOSPITAL MUSEUM.)

The epiphysis of the caput femoris has been practically destroyed, and the acetabulum is enlarged by absorption of its posterior margin and displaced upwards (*travelling acetabulum*). The rami of the ischium and pubes have been removed.

FIG. 249. — EARLY STAGE DISEASE (RIGHT SIDE CHILD. (FROM A PHOT

The black line is drawn f anterior superior spine other, and shows not amount of abduction pre also the tilting down pelvis on the affected sid

the deposit of osteophytes, or carious; if sepsis is present may also supervene.

Clinical History. The patient, usually a child, is observe and may complain of pain either in the hip or inner side of the latter being due to the fact that both joints are suppli same nerves, viz., the anterior crural, sciatic, and obturat There may be some history of injury, but not necessa examining the limb in the *early stage*, it is usually fou

apparently lengthened (Fig. 249), whilst the thigh is slightly wasted. The nates are flattened, and the gluteal fold lost, conditions partly due to atrophy of the muscles, partly to the flexion of the limb. The joint is more or less rigid, and pain is produced on attempting to move it, or on jarring the leg, as by striking the heel or trochanter. The position assumed in this early stage is one of slight and increasing flexion, abduction, and eversion (Fig. 250, A), the reason for this being that thereby the ligaments, and especially the ilio-femoral, are most relaxed, and the capacity of the joint is at its greatest. The latter fact has been demonstrated in the healthy cadaver by inserting the nozzle of a syringe into the joint through the acetabulum, and forcibly injecting fluid, when this position is at once assumed. The flexion and abduction, however, are not always evident, since the flexion is masked by lordosis of the spine (Figs. 251 and 252), and the abduction

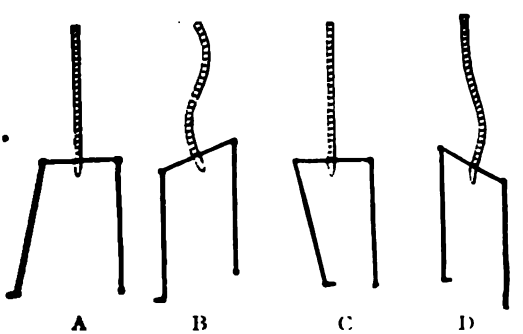


FIG. 250.—DIAGRAM TO ILLUSTRATE THE POSITIONS ASSUMED BY THE LIMB IN THE EARLY AND LATE STAGES OF HIP DISEASE.

A represents the position of abduction taken by the right limb in the early stage of hip disease, and B, Nature's method of masking this by tilting the pelvis down on the affected side, whilst the other leg is adducted; the effect of this on the spine, in causing a lateral deflection, is also indicated. C shows the same thing in the later stage, when adduction is present, and the pelvis is tilted upwards on the affected side, thus producing apparent shortening (D).

by the pelvis being tilted down on the affected side, producing thereby apparent lengthening of the diseased limb and lateral curvature of the spine, with its lumbar convexity towards the affected side (Fig. 250, A and B). The sound leg being brought into a position of adduction, the parallelism of the limbs is maintained. The flexion can be demonstrated by any method which obliterates the lumbar curve of the spine, as by fully bending up the sound limb on the abdomen, the affected thigh rising at once from the bed and forming an angle which indicates the amount of flexion (Fig. 252). The abduction is demonstrated by laying a rod across the two anterior superior spines, and placing another at right angles to its centre. This will not correspond with the line of the body or of the limb, but makes an angle with it. The eversion cannot be masked. The rigidity is easily demonstrable

in that all movements of the hip-joint are greatly limited; thus if attempt is made to bend the affected thigh on the abdomen, t corresponding side of the pelvis is raised with it from the bed.

As the disease progresses, and the bones become more extensive affected, the pain increases, with nocturnal startings, whilst abscesse form, and a certain amount of fever and constitutional disturbance i caused thereby. The position of the limb also changes; for althoug the flexion is maintained and even increased, adduction and inversio are now associated with it. The pelvis is tilted up on the affecte side (Fig. 250, C and D), causing *apparent shortening*, lateral curvatur with a lumbar convexity to the sound side, and abduction of th

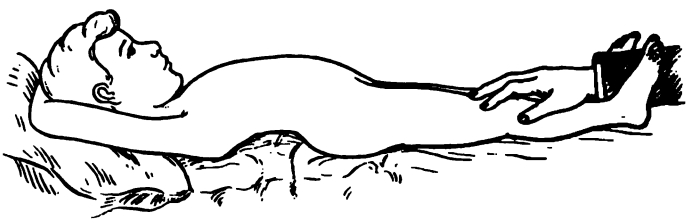


FIG. 251.—HIP DISEASE, WITH WELL-MARKED COMPENSATORY LORDOSIS, CAUSED BY EXTENDING THE LEGS FLAT ON THE TABLE.

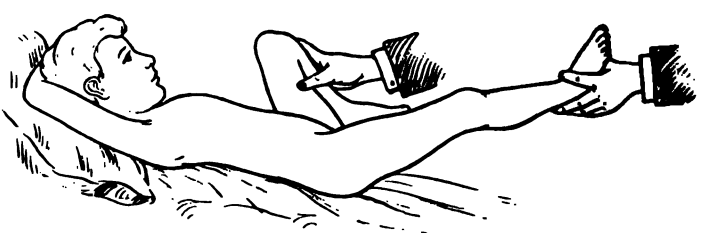


FIG. 252.—ON FLATTENING THE SPINE AGAINST THE COUCH BY RAISING TH UNAFFECTED LEFT LEG AND PRESSING IT UP AGAINST THE ABDOMEN, TH DEGREE OF FLEXION OF THE RIGHT THIGH AT ONCE BECOMES OBVIOUS.

healthy limb. No satisfactory cause for this position can be give but it is usually attributed to the yielding of the posterior and ou part of the capsule, together with infiltration and weakening of t small external rotator muscles, allowing the adductors and inter rotators unopposed play.

When an abscess has formed, the most usual situation for it point is a little in front of and internal to the great trochanter, cl to the insertion of the tensor fasciæ femoris. It may reach that s either from an opening in the anterior part of the capsule, com thus to the surface along the line of least resistance, or it may burr from the posterior portion of the capsule along the rotator musc and superior gluteal nerve. Less frequently abscesses pass direct backwards to open in the gluteal region, or forwards along the pubo

femoral ligament, pointing on the inner side of the femoral vessels below Poupart's ligament. As a rare complication, the tuberculous process may extend to the bursa under the psoas tendon, which usually communicates with the joint, leading to the formation of an abscess in the lower part of Scarpa's triangle, and occasionally a typical psoas abscess results from an extension upwards within the sheath of the muscle of a tuberculous infection from this bursa. An intra-pelvic abscess following perforation or disease of the acetabulum may either burrow upwards, and come to the surface on the inner side of

A B

FIG. 253.—POSITION OF THE LIMB IN THE LATER STAGES OF HIP DISEASE.

In A a white line has been drawn between the two anterior superior spines to indicate the tilting of the pelvis upwards on the affected side necessitated by the adduction of the limb. Some amount of flexion was present, but this was not marked. In B the secondary curves of the spine are well seen.

the vessels above Poupart's ligament; or it may gravitate downwards, and burst in the ischio-rectal fossa, close to the tuber ischii.

The final stage of the disease is one of *real shortening* (Fig. 253), due to erosion of the head of the bone and its displacement backwards upon the dorsum ilii. The position assumed is one of increased flexion, adduction, and inversion; whilst if septic sinuses persist, hectic fever and amyloid changes in the viscera are likely to follow.

At any stage cure by ankylosis may be obtained; but unless the

abnormal position has been corrected by extension, deformity is almost certain to be present.

The **Diagnosis** of hip disease appears to be a matter of considerable difficulty to some, if we may argue from the mistakes which commonly occur. The pain in the knee present in the early stages leads to its frequently being mistaken for disease of that articulation; a very slight amount of care in the examination should prevent such an error. From disease of the *opposite hip*, it is recognised by the relative mobility of the thigh on the two sides. The diagnosis from *sacro-iliac* disease is given at p. 695. *Spinal mischief* may also be confounded with it, if a psoas abscess points at any of the ordinary situations in which sinuses form in connection with the hip-joint. The presence of spinal deformity and the ability to perform the test movement for hip disease should readily enable the surgeon to make a correct diagnosis, but it must not be forgotten that the two conditions may co-exist. If the limb can be put into what is known as the tailor's position—that is, flexion to a right angle with marked abduction and eversion—one may be practically certain that hip disease is not present.

An *encapsuled abscess in the neck of the femur* is a condition which it is very difficult to distinguish from true hip disease. A constant deep boring pain is complained of, which is increased by pressure over the neck, or by jarring the trochanter; but if the limb is manipulated gently, it can be proved that the movements of the joint are not really impaired. Radiography is a useful aid in making a diagnosis of this condition.

The **Prognosis** of hip disease is by no means unfavourable if the condition is properly treated. Of course, the patient is liable to develop acute tuberculosis or tuberculous disease elsewhere; or, if abscesses are allowed to become septic, serious complications—such as pyæmia, sapræmia, hectic and amyloid disease—may ensue. Apart from these, however, no serious consequences affecting life need be feared, although the usefulness of the limb may be seriously crippled from shortening or ankylosis, especially if the latter occurs in a faulty position.

The **Treatment** of hip disease must be conducted along the same lines as for tuberculous lesions generally. In the *early stages* the limb is kept at rest by the application of a Liston's splint, or it may be placed between sandbags, and a weight and pulley attached. By this means not only is rest assured, but deformity is prevented. If the amount of flexion is slight, the limb may be allowed to lie on the bed in the horizontal posture; this will possibly induce some compensatory lordosis, but as the muscular spasm relaxes, the curvature of the spine disappears. When, however, a considerable degree of flexion is present, extension must be made along the axis of the flexed limb, which is supported on pillows. It will be found that after a few days the flexion diminishes, and the limb will then gradually assume the horizontal position. Should this precaution not be adopted, the extension merely produces lordosis, and the pain from intra-articular tension is increased thereby. The general health of the patient must

PLATE XXX.

SKIAGRAM OF PELVIS, SHOWING TUBERCULOUS DISEASE OF RIGHT HIP-JOINT.

The head of the bone is displaced upwards, irregular in shape, and evidently invaded with granulation tissue. The acetabulum is similarly affected

at the same time be attended to, and cod-liver oil and syrup of the iodide of iron may be administered with benefit. When the more urgent symptoms have disappeared, a Thomas's hip-splint is applied, so as to enable the patient to get about (Fig. 254). This consists of a flat bar of malleable iron, about an inch and a half wide, extending from the axilla to below the knee; it is shaped so as to fit the varying curves of the body, and cross-pieces embrace the trunk at the level of the nipples, as also the thigh and the calf; it is firmly bandaged to the body and limb. A patten is placed under the boot of the sound leg, and the patient allowed to get about on crutches. This apparatus should be worn for at least six months after all signs of active disease have disappeared. It may also be employed in the earlier and more painful stages if it is at first bent so as to accommodate itself to the flexed position of the limb; as the effect of the rest becomes evident in a diminution of muscular spasm, the splint can gradually be straightened out, so that at length the limb is fully extended.

FIG. 254. — THOMAS'S HIP-SPLINT APPLIED.

When abscesses form, they may be opened antiseptically and drained, or preferably tapped and injected with iodoform, the former precautions as to rest and constitutional treatment being still maintained. More extensive operative measures—such as *excision* of the head by the *anterior* method (p. 699)—are sometimes undertaken in the early stages to cut short the disease, especially when prolonged treatment is impracticable, as amongst the poor, or when the general health and constitutional powers are defective. The removal of the whole head necessarily involves the upper epiphysis, and hence defective growth of the femur results, as well as immediate shortening. For these reasons, as also because repair is possible in most cases without operation (when there is a certain amount of recuperative power and prolonged treatment is feasible), this proceeding, at one time so common, is being discarded more and more in favour of conservative measures.

It is sometimes possible, however, to save some portion of the head, and if so, this should always be attempted. A very successful series of cases has recently been published, in which the joint was opened from the front, the interior freely curetted (in one case after a temporary dislocation of the head), the bone scraped, and in more than one case a channel gouged along its anterior wall to expose and remove a deep focus. Indeed, when one attempts to save the head of the femur in this way, it is always well to remove the compact tissue from the front of the neck so as to expose and explore the epiphyseal line. By this plan, shortening and defective growth can to a large extent be avoided.

In the *later stages*, and especially when sinuses have formed in t gluteal region or behind the trochanter, *excision* by the *posterior* meth (p. 699) is preferable; this is usually an easy matter, since the he is probably eroded and displaced. The sinuses should, if possible, included in the incision, but under any circumstances must be open up and scraped. When the acetabulum is extensively implicat the disease can only be satisfactorily dealt with by removing the he of the bone, and the posterior method affords the best means subsequent drainage; of course, this presumes that the general co dition of the patient has not been seriously undermined, and that the is a good prospect of gaining a useful limb. Otherwise *amputati* through the hip-joint is required, especially when the mischief h extended into the pelvis, or when, after excision, a weak, flail-li limb results or osteo-myelitis supervenes. It is also needed wh after excision sinuses persist and lead down into the acetabular cavit from which there is a plentiful secretion of pus, and over the entran to which the upper end of the femur is drawn, thereby obstructi the escape of the discharge, and rendering dressing both difficult a painful. The operation often gives most excellent results, the patien condition rapidly improving. Removal by the anterior racq method is perhaps the most convenient.

Disease of the Sacro-iliac Joint.

Tuberculous disease of this joint is most commonly met with adults, but rarely in children. It may commence in the syno membrane, but is frequently the result of mischief starting in pelvic bones, especially the ilium. The **Pathological Anatomy** c for no description, inasmuch as it follows the ordinary course tuberculous disease.

The **Clinical Signs** consist of pain and a sense of weakness in lower part of the back, increased by standing, walking, or any mo ment—such as coughing, sneezing, and the like—which calls the abdominal muscles into sudden action and drags on the ilium. I of a very unpleasant character, a sensation as if the pelvis were com to pieces being experienced by the unfortunate individual. Owing the fact that the lumbo-sacral cord passes in front of the articulat pain is often referred to the gluteal region or down the leg. Mo ments of the limb cause pain if the pelvis is not supported, but ca freely performed if the pelvis is steadied. Compression together of innominate bones, or their forcible separation, is the means of m effectually demonstrating the existence and situation of the pain. T patient is unable to stand or to put any weight on the affected lim and hence limps during walking, allowing his body to lean forwar and making use of a stick. There is apparent lengthening on t affected side, but on measurement from the anterior superior spine to t internal malleolus the leg is found to be of the same length as its fello This appearance is due to the fact that the whole innominate bone i tilted downwards and forwards, so that the anterior superior spine is a lower level and more prominent than that on the opposite side. Th region of the synchondrosis is often swollen, puffy, and tender; whil

after a time abscesses form, which may either point immediately over the articulation, or burrow upwards into the lumbar region, or forwards into the groin, or downwards into the pelvis, opening in the ischio-rectal fossa. The last is a most serious complication, since it necessarily introduces the septic element.

The **Diagnosis** needs to be made from sciatica, hip disease, and spinal disease. *Sciatica* is known by the character of the pain, which shoots down the back of the thigh in the course of the great sciatic nerve, which may be distinctly tender on pressure. There is no apparent elongation of the limb, and compression together of the pelvic crests is painless. From affections of the *hip-joint*, sacro-iliac disease is recognised by the fact that, if the pelvis is supported, the thigh may be moved in all directions without great discomfort; whilst compression of the pelvis in hip disease causes no pain. Moreover, in the advanced stages of hip disease, there is apparent or real shortening, a condition never noticed in the sacro-iliac affection. From *spinal disease*, the diagnosis should not be difficult if a careful examination of the spine and pelvis is made.

The **Prognosis** of sacro-iliac disease, though usually stated to be unfavourable, is not necessarily so if asepsis is maintained; it is the admission of the septic element that constitutes the main danger. When affecting girls, it may lead to subsequent deformity of the pelvis and trouble in parturition.

Treatment in the early stages consists in absolute rest, with the application of a pelvic support, and attention to the general health, combined possibly with local counter-irritation. When abscesses form, they should be freely opened, and if diseased bone can be felt with a probe, it should be scraped or cut away, and the parts swabbed over with pure carbolic acid. Occasionally it is necessary to remove the posterior part of the iliac crest in the neighbourhood of the posterior superior spine in order to gain access to the diseased area; this may be accomplished by the chisel or trephine through a vertical incision, and we have had a number of excellent results from this proceeding.

Excision of Joints.

Excision of joints is an operation which, though formerly undertaken in a few isolated instances for compound fractures and dislocations, has only during the past fifty years been established on a scientific basis, or utilized to any great extent. The late Sir William Fergusson was one of the chief pioneers in this branch of operative surgery, and to his skill and insight we owe much of what has thus been gained. Since the introduction of antisepsis, however, the operations have been still further elaborated, and excision is now undertaken for many conditions that formerly would not have been so treated. The chief articular lesions for which excision, partial or complete, is now recommended are as follows: (1) For compound dislocations or fracture-dislocations; (2) for various forms of simple or comminuted fracture in the neighbourhood of joints where ankylosis is likely to follow, and either interfere seriously with the utility of the joint or fix it in a bad position:

the shoulder and elbow are the joints most frequently dealt wi
way; (3) for some forms of congenital or old-standing di
which cannot be otherwise remedied; (4) in the later stages
arthritis, where the ends of the bones are carious, the j
organized, and chronic suppuration is present; (5) in tul
arthritis, where palliative treatment has failed to cut short th
or where disorganization of the joint has occurred with erosi
ends of the bones; (6) for ankylosis of certain joints, conse
arthritis, either acute, tuberculous, or syphilitic, especially if
position; (7) for osteo-arthritis in special regions.

The results to be attained necessarily vary in the differe
and according to the particular causes. Sometimes ankyl
good position is all that can be expected, in others a freely m
pseudarthrosis; in some cases the removal of certain disease
is the primary object of the operation, whilst in others no d
present. All these varying conditions must be taken into cons
in determining the nature and extent of any excision.

The late Professor Ollier of Lyons emphasized and establi
benefits to be derived from subperiosteal resections in certa
Necessarily, every excision must lead to considerable inte
with the peri-articular structures; muscles and tendons ha
detached from their insertions, and portions of the bones rem
however, the periosteum is raised, together with the attached
and tendons, prior to sawing or cutting the bones away, a m
factory reproduction of the articular structures follows, and th
ments of the joint suffer less interference than if one cuts a
periosteal envelope with the bone. Of course, where the pe
is invaded with tubercle, this should not be attempted, whilst
joints—such as the elbow—there is no advantage to be deriv
it, since there is always a tendency to too great a formation
and this would possibly be exaggerated by a subperiosteal r
It is rather in the operations undertaken for traumatic lesi
this plan is to be recommended.

In a small text-book like this we must perforce limit ourse
description of the methods most commonly adopted, and refer
to special works on Operative Surgery for further details.

Shoulder-joint.—Excision of the shoulder-joint may be needed for tu
disease, for the later stages of acute arthritis, occasionally for osteo-
the disease is limited to this articulation, for compound or comminuted
and possibly for simple fractures of the anatomical neck when associ
dislocation of the small detached head of the bone. In old unreduce
tions where passive movement is impracticable, and there is little ho
provement, excision may give excellent results.

Operation.—The patient lies on the back, the shoulder projecting s
over the edge of the table, and with a sandbag beneath the scapula to
The arm being slightly rotated inwards, an incision is made from a p
way between the coracoid process and the acromion, extending down
outwards for 3 or 4 inches through the fibres of the deltoid muscle (Fig
It is better to incise the deltoid than to pass between it and the pectora
the cephalic vein and accompanying artery being thus uninjured. Th
is thoroughly opened up by means of retractors, and the bicipital groo
for; an incision is made along its outer border, and the long tend

biceps, if still present, turned out, and held to the inner side by a blunt hook. A twig of the anterior circumflex artery will here be divided, and need a ligature. The arm is now thoroughly everted, and the tendon of the subscapularis and the anterior part of the capsule, with which it is incorporated, freely divided; where practicable, the attachments of the muscle to the bone should be separated subperiosteally, a proceeding presenting no difficulty where inflammation has previously existed. The arm is now inverted and held downwards by the side of the table, so as to bring the great tuberosity into view; the muscles attached to this process are dealt with in a similar way, and the upper part of the capsule freely opened. The head of the bone is then protruded into the wound, and removed by the saw. It will often suffice to apply the saw obliquely through the substance of the tuberosity; this is to be preferred to removal of the whole tuberosity by a horizontal incision at a lower level. The synovial membrane and glenoid cavity are dealt with as circumstances may dictate, and it is often advisable to make a counter-opening through the posterior axillary fold for the

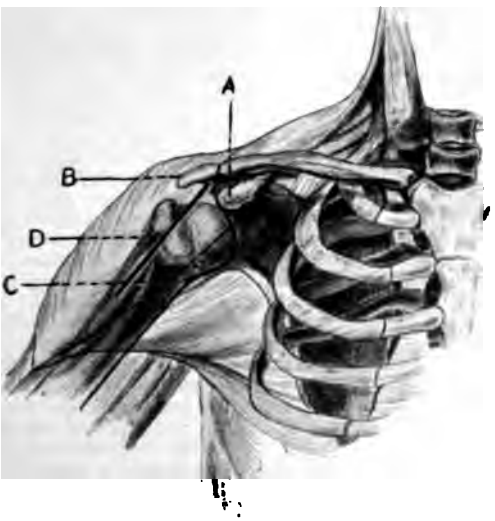


FIG. 255.—INCISION FOR EXCISION OF SHOULDER.

A, Coracoid process; B, tip of acromion; C, intermuscular line between deltoid and pectoralis major; D, incision.

insertion of a drainage-tube; the anterior wound can then be entirely closed. In applying the dressing, care must be taken to put a good pad in the axilla, so as to keep the arm from being drawn forcibly inwards by the muscles attached to the bicipital groove. There is no need to commence passive movements before the end of the first week. Fibrous union usually results, and the movements of the shoulder are generally very good.

Excision of the Elbow may be required for simple or compound fracture-dislocation, or for subsequent ankylosis, especially if the limb is in a bad position, for tuberculous arthritis, and possibly in the later stages of acute arthritis. The best plan of operating is as follows: A single longitudinal incision, 5 inches in length, is made in the middle line of the posterior aspect of the joint, extending for equal distances above and below the tip of the olecranon, and a little to the inner side. The limb is held across the patient's body, the surgeon standing on the affected side. The incision extends through the substance of the triceps down to the bone. The origin of the flexor carpi ulnaris and the inner half of the triceps

tendon are detached, and the hollow between the olecranon and th condyle cleared, the knife being kept close to the bone, and the soft parts by a vigorous use of the thumb-nail. By this means the ulnar nerv injury, and, indeed, is often not seen at all. The internal lateral ligame be divided, and the common origin of the flexors from the front of t condyle. The outer half of the joint is then dealt with in a similar anconeus being divided close to its insertion to the ulna, the continu triceps with the deep fascia covering it being also maintained. The ori extensor muscles is separated from the back of the outer condyle, and th lateral ligament severed. The joint can now be freely opened by divi of the fibres of the posterior ligament which remain intact, and the ends of the bones protruded from the wound. The lower end of the h now thoroughly cleared, and the surface removed, the section through the centre of the olecra The olecranon, together with t articular surface of the coronoi and the head of the radius, are n off, care being taken to draw a protect the soft parts by retract cially those covering the uln The synovial membrane can with as may be necessary. Ev head of the radius is free from nothing is gained by leaving since ankylosis is very likely t unless plenty of bone is remov general rule, a gap of 2½ inche intervene between the divided the bones. For a similar rea periosteal resection is needl indeed, is an undesirable re The wound is carefully suture drainage-tube inserted for a fe The limb is kept on a hinged splint for a week, by which tim of the external wound should plete, but the position is altered After a week, the splint may be d with, and the limb kept at r pillow, free passive moveme angular and rotatory, being da tised. Considerable attention h in order to obtain a good result, successful case every movemen joint is perfectly restored. As a lower end of the humerus devel lateral bony processes, like within the grasp of which the upper rounded ends of the radius and able to move.

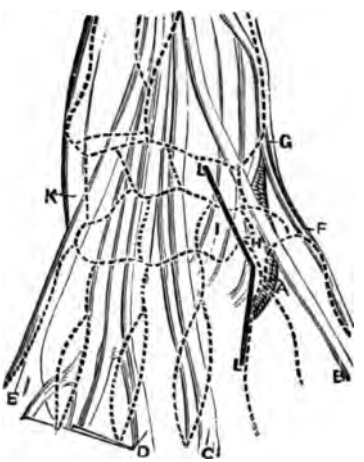


FIG. 256.—EXCISION OF THE WRIST. (LISTER.)

A, Radial artery; B, extensor secundi internodii pollicis; C, ext. indicis; D, ext. communis digitorum; E, ext. minimi digiti; F, ext. primi internodii pollicis; G, ext. ossis metacarpi pollicis; H, ext. carpi radialis longior; I, ext. carpi radialis brevior; K, ext. carpi ulnaris; L, L, line of radial incision.

The **Wrist-joint** is only excised for extensive tuberculous disea abscesses and sinuses are present. Ankylosis of the articulation, t troublesome condition, is not sufficiently so to require such treatment. method to employ is that known as Lister's operation, a somewhat com proceeding, but which in suitable cases gives excellent results. Prior to o the fingers are well bent, so as to break down any adhesions which are Two incisions are made, one on the radial side of the dorsum, and the the inner or ulnar aspect of the wrist. The dorsal incision is angular (L, L), commencing at a point on the back of the radius between the te the extensor secundi internodii pollicis (B) and the extensor communis d (D); it is at first parallel to the former tendon, and on its ulnar side, till i

the base of the second metacarpal bone, when its direction is changed, and it courses downwards along that bone for an inch or two. It should extend to the bone, and in doing so the tendons of the extensor carpi radialis longior and brevior (H and I) are divided as close to their attachments as possible. The tendinous structures are then stripped off the back of the dorsum on either side of the incision, and on the outer side a pair of cutting pliers is insinuated so as to detach the trapezium from the rest of the carpus. The synovial sheaths of these tendons should, if possible, not be opened. The hand is then rolled over, and the ulnar incision made well on the inner side of the limb, extending for at least 3 inches between the extensor and flexor carpi ulnaris tendons. The separation of the extensor tendons from the back of the carpus is now completed, and the attachment of the extensor carpi ulnaris (K) divided. The tissues on the palmar aspect of the joint are detached, the pisiform being severed from the rest of the carpus, and where possible left, and the hook of the unciform clipped off with cutting pliers. The carpus is now free front and back, and the bones are either removed piecemeal or taken away *en bloc* by inserting a pair of cutting pliers above and below, and dividing their upper and lower connections; more usually the carpal bones are picked out in fragments. Attention is then directed to the lower ends of the radius and ulna, and to the articular ends of the metacarpal bones, all the cartilage and the intervening synovial tissue being cleared away. Finally, the remaining fragments of the carpus are dealt with as the case may require. The radial incision may often be entirely closed, whilst a drainage-tube is inserted through the ulnar wound. The hand is placed on a special splint, with a thick convex cork support for the palm, which keeps the wrist slightly extended, and with a short lateral projection upon which the thumb can rest. The fingers must be thoroughly flexed and extended daily, beginning on the second or third day, but the wrist should be kept at rest until it is quite firm. There is a much greater tendency to a flail-like joint than to undue fixity, owing to the amount of bone removed, and the necessary division of all the extensors of the carpus; if such occurs, a leather support must be worn, either as a temporary or permanent appliance.

The **Hip-joint** is rarely excised for conditions other than tuberculous disease, and even for this it is performed much less frequently than formerly. There are two chief methods of operating, the anterior and the posterior.

1. Excision by the *anterior method* is carried out as follows: The incision (Fig. 90, D; p. 336) extends from immediately below the anterior superior spine vertically downwards for 3 or 4 inches. It passes between the tensor fasciæ femoris and sartorius muscles superficially, and between the glutei and rectus deeply, a small arterial twig from the external circumflex being divided at this stage. The neck of the bone and capsule of the joint are exposed, and the latter is freely incised along its attachment to the anterior inter-trochanteric line, so as to allow of the admission of the finger, whereby the joint can be fully explored. The neck of the bone is cut through *in situ* by means of an Adams' osteotomy saw, the incision through the bone being placed obliquely downwards and inwards. The head of the bone is now either prised out of the acetabulum by an elevator, or grasped by lion forceps and twisted out, a matter easily accomplished where the articular structures are diseased, but a proceeding of some difficulty in the normal joint of a cadaver. As much of the infected synovial membrane as possible is clipped away with scissors, and the acetabulum scraped, if necessary. The external wound is either closed, with the exception of an opening for a drainage-tube, or stuffed with gauze soaked in iodoform emulsion. There may be comparatively little shortening of the limb as the result of this proceeding, but the movements are considerably limited.

2. Excision by the *posterior method*, as we have already said, is usually undertaken in the later stages of the disease. Any sinuses which exist posteriorly may be utilized, but if the skin is unbroken, an incision known as Langenbeck's may be employed (Fig. 257). The patient lies on the sound limb, whilst the affected thigh is flexed. The incision is made in the line of the femur, extending 2 inches above the top of the great trochanter, and about 3 inches below it. It is carried at once down to the bone, and the muscles attached to the summit and posterior border of the great trochanter freely divided, as close to the bone as possible.

The capsule is opened to a sufficient extent to allow of the explora joint by the finger. If the disease is very extensive, the femur is no across, immediately below the great trochanter, but above the lesser. end of the bone is grasped by lion forceps, and twisted out of the a after division of the remaining structures, which are attached chiefl anterior border. The ligamentum teres has almost always been destroyed, and hence this stage of the operation is not especially diffi synovial membrane and acetabulum are easily reached, and the disease removed. In favourable cases a drainage-tube may be inserted, and closed, but not uncommonly it is wiser to partially stuff it with gauze with iodoform, and allow it to heal by granulation. Slight extension should be subsequently made, so as undue shortening from the traction thigh muscles. The leg is placed bet bags, or a Liston's long splint applied ankylosis, with a certain limited amou ment, is the usual result.

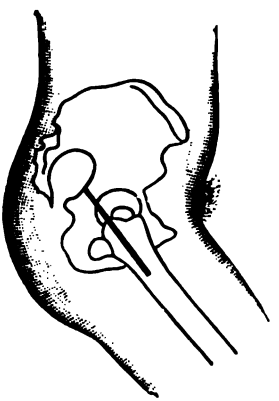


FIG. 257. LANGENBECK'S INCISION FOR EXCISION OF THE HIP FROM BEHIND. (TILLMANNS.)

It is not always necessary to inclu chanter in this operation. If the disea to the head of the bone, it alone sh moved, with as little disturbance as the muscles passing to the trochante can be effected, the subsequent mobili fulness of the limb are considerably in

The advantages claimed for the ante are: that it is a less severe operation, muscles and tendons are interfered wi vessels of importance are divided, an the head of the bone is excised. The to it are: that the drainage provided satisfactory, that the trochanter cannot dealt with, whilst it is also difficult to the synovial membrane.

The great advantages of the posterio are that, in spite of a free division of th and tendinous attachments, excellent provided, and both trochanter and are readily accessible. On the whole, the anterior method should b in the early stages of the disease, the posterior in the later. The abscesses or sinuses may, however, determine the choice of the surgeo

The **Knee-joint** is excised for tuberculous disease, osteo-arthritis, o due to osseous or fibrous ankylosis in a bad position. A horsesh incision is made, extending from the back of one condyle to the othe downwards nearly as far as the tubercle of the tibia. The limb is well ligamentum patellæ divided, and the joint opened. The skin and su tissues are then separated from the anterior surface of the patella, be at once removed by a curved incision above it, communicating on with that already made below, the subcrureal pouch of synovial memb also removed during this dissection. The flexion is now increase lateral ligaments divided; by this means the interior of the join exposed, so that the attachments of the crucial ligaments to the tibi be severed. The lower end of the femur is then cleared of disease membrane, so as to allow of the application of a broad excision saw. rule given as to the direction of the saw-cut in the bone is that the ex surface left after removing its articular end should be absolutely supposing the patient to be standing upright; personally, we prefer t sections so that the limb shall be left very slightly flexed and in-kneed which greatly adds to the subsequent comfort of the patient. To this the saw must be applied parallel to the articular surface—*i.e.* angles to the axis of the body, not of the femur, and with a slight up from before backwards. The bone should be partially sawn through

ovement, but the posterior surface of the condyles should be divided by r depressing the handle of the instrument, so that the structures lying a the intercondyloid notch are not encroached upon. Sufficient bone e sawn off in the adult to include the greater part of the articular but as little as possible consistent with removing all the disease, other- imb is shortened to such an extent as to interfere with its subsequent s. The head of the tibia is then protruded, and cleared from the neigh- oft parts; it is held absolutely vertical, and a saw applied in a horizontal the bone being divided from before backwards. Any diseased synovial e is now dissected away, special attention being directed to the posterior the joint. All bleeding-points having been secured by ligature, the : fitted together, and, if considered advisable, secured in position by r wire, or silver-plated nails or screws. The external incision is closed, tubes being inserted at each angle of the wound, if need be. A Gooch's applied to the limb, and in this it remains until sound healing has after which an immoveable case either of plaster of Paris or water-glass until eight or ten weeks have elapsed since the operation.

kle-joint is excised for tuberculous disease. Two incisions are made, an l an outer. The outer incision runs along the anterior border of the l curves round the outer malleolus, being about 3 inches in length. The l of the fibula is exposed, and by preference subperiosteally. The lateral ligament is split vertically, and separated from its attachments ula, its continuity with the periosteum being, however, maintained. a is then divided about 1 inch above the tip of the malleolus, and the latter f bone removed. The periosteum and ligaments are separated as far as rom the front and back of the bones. The inner incision is T-shaped, ade along the inner surface of the tibia, with a short transverse cut at end, which reaches just below the inner malleolus. The periosteum nal lateral ligament are dealt with as on the outer side, and the front of the tibia are easily denuded. The inner malleolus is projected from d, and the lower end of the tibia removed by a keyhole saw, the dorsal s being held aside by a retractor. The articular surface of the astragalus ff from the outer wound, or, if advisable, the whole of the bone may be

ove subperiosteal method of excision is one of the best that have been l. The greatest care should be taken not to open the sheaths of the and in dressing the wound the foot must be kept at right angles to the no lateral deviation permitted. As soon as possible it is encased in Paris, windows being left for the dressing of the wounds, if necessary. tuberculous cases a transverse incision extending from one malleolus to may be employed. Sutures are placed through the tendons above and d they are then divided; the anterior tibial nerve is similarly secured d below before division, and the vessels are divided between ligatures. ng the capsule a very free exposure of the joint surfaces is provided, g a very thorough excision. The divided tendons and nerve are carefully ogether before closing the wound.

n of the **Astragalus** is sometimes required in the treatment of tuberculous contiguous joints, as also in some cases of talipes and of fractures or ns of the bone. Many methods of operating have been described, but it is best accomplished through a single vertical incision over the front kle, running parallel to the vessels and tendons, which are carefully nd stripped back from the dorsum by means of periosteal detachers, so pper surface of the astragalus can readily be reached The astragalo- joint and ankle are then freely opened, and the ligamentous and fascial ns on either side severed. The neck of the bone may with advantage d at this stage, and its head removed, so as to give access to the under nd allow of the division of the strong interosseous ligament extending the adjacent surfaces of the astragalus and os calcis. It may be possible e the rest of the bone in one fragment, but it is certainly wiser to break h chisel or gouge, and take it away piecemeal.

CHAPTER XXIII.

INJURIES OF THE SPINE.

THE spinal cord is protected from injury in a most complete a[illegible] efficacious manner. (*a*) Its position between the bodies and [illegible] laminæ with the spinous processes arising therefrom is its[illegible] mechanically advantageous, since, whether the spine is forci[illegible] flexed or extended, the cord remains midway between the points[illegible] chief compression or extension, and hence in a position of re[illegible] (*b*) The buffer-like action of the intervertebral discs, and the varyi[illegible] curves of the column, serve to distribute some part of any force th[illegible] reaches it. (*c*) There is ample space in the medullary canal, [illegible] which the cord with its membranes is slung by prolongations of du[illegible] mater around the issuing nerves, whilst the cord itself hangs loos[illegible] within the dura mater, suspended by the ligamenta denticulata, [illegible] surrounded by cerebro-spinal fluid. (*d*) The cord terminates, in [illegible] adult, at the lower border of the first lumbar vertebra, a spot w[illegible] above the junction of the fixed base and the moveable upper p[illegible] a point where the effect of jars and wrenches is mainly f[illegible] (*e*) Nature has, moreover, introduced a whole series of buffers [illegible] other means of preventing shock to the spine when a person falls[illegible] his feet, *e.g.*, the arches and elasticity of the foot, the changes in di[illegible] tion of the bones at each joint, the inter-articular cartilages of [illegible] knee, etc.

The parts of the spine most exposed to injury are those whe[illegible] fixed and moveable portion meet, *e.g.*, the dorsi-lumbar and [illegible] cervico-dorsal regions. The upper part of the dorsal curve, wh[illegible] is relatively weak and projects backwards, is thereby exposed [illegible] injury, so that fractures are not at all uncommon about the fou[illegible] dorsal vertebra. The close proximity of the head explains the [illegible] quency of lesions about the upper cervical region.

Sprains.

Sprains and strains of the spine are very common accidents, a [illegible] not to be wondered at, when we consider the complicated muscu[illegible] and ligamentous arrangements present. They are produced by [illegible] sudden or unexpected movements, such as falls, especially from hor[illegible]

back, railway accidents, and the like. The injury is most likely to affect mobile parts of the spine, *e.g.*, the cervical and lumbar regions, and may be limited to the ligamentous or muscular structures, or may involve both. The resulting **Signs** are simply those of a severe but localized trauma, viz., pain, tenderness, bruising, and perhaps a little swelling; the subjective phenomena are much increased by movement, so that the spine is always kept rigidly quiet. If only the muscles or interspinous ligaments are involved, no further consequences are likely to arise; but when the ligamenta subflava are lacerated and the spinal canal is thus opened, the gravest symptoms may ensue from blood finding its way into the canal outside the dura mater, leading possibly to paraplegia, which may be of a temporary or permanent nature. Inflammation of the damaged fibrous tissues may also extend to the meninges and cord, and cause compression of the latter or even organic disease. Moreover, in patients of a tuberculous temperament, spinal caries may be set up as a result of such injuries, whilst syphilitic or malignant disease has also been known to follow.

In the *cervical* region, sprains are very liable to occur as a result of severe blows on the head, causing rupture of the inter-transverse ligaments, and the displacement may be so great as to simulate dislocation. The head and neck are held immoveable and rigid, and there is often considerable loss of power, the patient being sometimes unable to lift the head spontaneously from the pillow. Sprains in the *lumbar* region are very common, both as a result of railway injuries, when they are often associated with nervous symptoms (p. 713), and as a consequence of overlifting, when the quadratus lumborum is most likely to be affected. The back is kept fixed and rigid, the patient being unable to turn or stoop without pain. Sometimes hæmaturia results from injuries in the lumbar region, arising from an associated contusion of the kidneys.

Treatment.—The patient should be kept at rest, and fomentations applied to the injured part. When the painful or inflammatory symptoms have disappeared, massage with stimulating liniments is needed. In the severer cases the individual should be kept in bed for six or eight weeks, and in the cervical region some form of mechanical support may be subsequently necessary. The appearance of inflammatory symptoms involving the meninges calls for greater care; the patient should then be kept as much as possible in the prone position, and a spinal icebag applied. The onset of paraplegia, due either to hæmorrhage or inflammatory exudation, would raise the question of laminectomy (p. 717).

Penetrating Wounds of the Spine.

These lesions are, fortunately, uncommon in civil practice, being generally due to stabs with pointed instruments, such as bayonets, or to gunshot wounds. They occasionally result from falls, the unfortunate individual becoming impaled on area railings, branches

of trees, etc. The **Symptoms** produced are: (*a*) those due to th wound in the soft parts, which may also involve the peritoneal an pleural cavities, or damage some of the viscera; in the neck, th vertebral artery is exposed to injury from this type of accident, lea ing to serious hæmorrhage; (*b*) various forms of fracture, the co being compressed by fragments of bone which have been driv inwards, or by extravasated blood; (*c*) those due to laying open t spinal membranes, *e.g.*, loss of cerebro-spinal fluid, which in its might prove fatal by draining the cerebral cavity, and so caus pressure on the base of the brain, or at a later date may determ the patient's death by setting up diffuse septic meningitis (p. 71 and (*d*) those due to wounds of the spinal cord. The effects o total transverse lesion at different levels of the spine are given p. 715; even if the patient escapes the dangers of diffuse se meningitis, he will later on develop acute myelitis. Of course, division of the cord may be only partial, or it may escape entir whilst nerve roots or trunks may be involved, and in the lumba sacral regions the cauda equina may be divided.

Treatment consists in thoroughly exploring the wound under anæsthetic, removing foreign bodies or displaced fragments of b and attempting to render it aseptic. Wounds of the vertebral ar or other structures are dealt with *secundum artem*, and special at tion is naturally given to the cord and its membranes. Should dura mater have been opened, and the cord have escaped injury attempt may be made to close the wound in the meninges, and patient should subsequently be kept in the prone position and the head low, so as to prevent, as far as possible, the escap cerebro-spinal fluid. If the cord itself is divided or lacerated, useless trying to unite it, since its function in conducting imp from the brain downwards is inevitably destroyed. Where, ever, the cauda equina has been injured, it is perfectly justifiab lay open the spinal canal to a sufficient extent to expose the div nerve trunks, and then to suture them.

Fractures of the Spine.

Causes.—The spine may be broken as the result of (*a*) *violence*, *e.g.*, a fall on the back over some projecting body, su a carpenter's bench or a railing, or a blow on the back with a stone or with a swinging baulk of wood, or a gunshot wound. type of accident may involve any part of the spine, and, ex those arising from gunshot, is less frequent than the class ne described. Of necessity, the spine breaks at the point stru posterior parts of the vertebræ are most likely to be damage form of injury. (*b*) Fractures are also due to *indirect* viole usually occurring in the lower cervical or upper dorsal They are caused by forcible flexion of the spine, as by a f stairs with the head doubled up, or by taking a 'header' int water, or when a man, being driven under a bridge, omits

aught between the arch and the cart, or sometimes by the avy weight on the back of the neck, the spine bending and t the weakest spot.

s of the spine may be divided into two main classes, to whether or not they are complete—that is, according to e continuity of the column is destroyed or not.

mplete Fractures may be met with in various forms, and equently due to direct violence.

tures of the Spinous Processes rarely occur except in the ical or dorsal regions. In the upper cervical region the short and retracted to allow of extension of the head, the lumbar they are also short, but very strong. The almost always due to direct violence, and is characterized s of a local trauma, together with great mobility, perhaps nd irregularity in the line of the spines. The process is y much depressed, and may even cause paraplegia by n into the spinal canal.

cture of the Laminæ is a not uncommon accident, always rom direct violence. If only one lamina is broken, the ot very distinct, and cord symptoms are rare. When æ yield, the posterior part of the neural arch, carrying e spinous process, is very likely to be depressed to a xtent to compress the cord and give rise to paraplegia. s often obtainable, and a gap in the line of the spinous an usually be felt.

cture of the Transverse Processes is but rarely met with apart lesions of the spine.

tial Fracture through the bodies may occur in the form of ich produce but little effect, except pain and rigidity, and diagnosed with certainty.

fractures where displacement is not present, paraplegic may arise, either immediately from concussion of the , or later on from the pressure of hæmorrhagic or inflam- sions.

atment merely consists in keeping the patient at rest for a e question of laminectomy for paraplegia, due either to nt of the laminæ or to hæmorrhage, will be discussed 7).

plete Fractures are usually associated with displacement, f continuity of the spinal column, and hence are often **acture-Dislocations**. They result either from direct or olence. There is always a tolerably extensive lesion ; thus, the spinous processes and laminæ may or may not d, the ligamenta interspinosa, supraspinosa, and subflava articular processes fractured in the lumbar and dorsal displaced without fracture in the cervical, and either the ral substance torn across, or the bodies broken, thus e spine into two halves. The upper or moveable portion driven forwards over the lower or more fixed fragment, and

impaction or comminution is often present. The spinal c
pressed between the upper end of the lower fragment and
of the upper fragment, and although the displacem
naturally remedied by the falling back of the bones i
('recoil'), yet the effects of the crush on the cord are usu
diable. In slighter cases the spinal membranes may be n
tured by a
bone, or l
may occur e
the membra
side them i
theca verteb
sive indirect v
lead to an ass
ture of the st

FIG. 258. — COMPLETE FRACTURE-DISLOCATION OF THE SPINE IN THE LOWER DORSAL REGION, WITH DISPLACEMENT AND COMPRESSION OF THE CORD. (AFTER KEEN AND WHITE.)

The **Signs** o
fracture are
evident, consi
pain, swellin
ing, and a cer
of angular
more or les
to circums
may be possi
crepitus, if t
not impacte
unnecessary
should be a
fear of addi
injury of the c
plegia below the part injured is present in most cases,
some amount of general shock. When the cord is disi
divided, symptoms of spinal myelitis rapidly follow, and
often occurs at an early date from toxæmia following se
or sloughing of the nates. The special phenomena of
are dealt with at p. 714.

The **Prognosis** of these cases turns largely on the situ
injury and the amount of mischief sustained by the
higher the lesion, the greater the danger, although p
paraplegia from cervical fracture may live for years, an
tially recover, if the cord has not been totally disintegrat

The **Treatment** naturally varies with the character
The patient is carefully placed on a prepared bed, the gre
ness being used in handling and lifting him, for fear of in
damage to the cord. The bed must be firm, though not ha
the best type to employ is a horsehair mattress placed o
boards; nothing more soft or yielding is permissible.
and wire-wove mattresses are most undesirable. A
required in the later stages, but should not be used at

firm enough. The shock resulting from the accident is
n the usual way by warmth and, if need be, by stimulants;
ust be remembered that anæsthetic regions of the body can
' blistered or burnt by hot-water bottles, unless carefully
by flannels. When reaction has occurred, a more thorough
ion of the patient can be made, and the subsequent course
decided on.

a small minority of the cases *operative treatment* is justifiable.
discuss later on (p. 717) the indications for laminectomy.
hen the displacement persists owing to impaction of the
s, *reduction* under an anæsthetic may possibly be undertaken,
that the lesion is not in the cervical region, and the para-
t complete. Of course, if other internal injuries are present
nder the case hopeless, nothing should be done. Great care
used in attempting reduction, since the object is to relieve
on the cord, and any undue violence may readily increase
hief; in the lumbar region, however, considerable force may
)yed without much danger. Whether reduction is accom-
r not, the further treatment must be directed in accordance
indications given in the next paragraph. Where the surgeon
educe the deformity, it may sometimes be advisable to make
xtension from the feet or neck by the use of weight and pulley.
many cases, as soon as the patient is laid flat on a bed, the
nent remedies itself, especially if the spine has been com-
and then the treatment must be *symptomatic*, as also after
1 or operation, where the paraplegia persists or is only slowly
d from. He is kept in bed, absolutely flat, and with the
r; perhaps some form of mechanical support, *e.g.*, a plaster
or leather jacket, may be considered advisable; but its
on is always a matter of difficulty, and in the early stages it
t little good. Food is regularly administered, and at first
light and readily assimilable.

:hief care of the attendants must be directed to the skin,
and bowels. *Bedsores* are extremely liable to form on all
f pressure, and hence the nates and heels must be carefully
(p. 107). In turning the patient to attend to the nates, the
ist be rolled over as a whole, and not merely the pelvis twisted.
)ften be found advisable to have a divided mattress placed
the pelvis, so that one lateral segment may be removed at a
id thus rotation of the body will not be needed. A bedpan
o be used in this way without disturbing the spine. When
der is paralyzed, the urine must be withdrawn by a catheter.
the greatest dangers that the patient runs is from the super-
of septic cystitis, and the extension of the inflammation up-
to the kidneys. This is always due to infection from without,
greatest care must be taken to prevent it. The penis should
oughly purified, and the urethra well flushed out before passing
rument in these cases; in the intervals between instrumenta-
e penis is wrapped in a dry sterile dressing. Only soft rubber

catheters are employed, and these must be kept absolutely aseptic by immersion in 5 per cent. carbolic lotion, or 1 in 1000 sublimate, which is subsequently removed before use by washing with a solution of boric acid. Should sepsis occur, the bladder is irrigated twice daily with some mild antiseptic, such as Condy's fluid, boric acid, boroglyceride (1 in 20), or sanitas (1 in 20), whilst urotropine, salol or boric acid in 10-grain doses may be administered by the mouth three times daily. Probably, in spite of all precautions, the condition will persist and prove fatal from extension to the kidneys. The *bowels* are always obstinately constipated, and must be opened either by purgatives or simple enemata.

Under such a régime the patient may gradually recover, but more often succumbs to septic poisoning or exhaustion. Occasionally he may live for a long time, although paralyzed, possibly developing some amount of reflex micturition, if the lumbar centres are not involved. Varying degrees of restoration of power in the lower limbs are also met with.

Dislocations of the Spine.

By dislocation of the spine is meant a displacement forwards, either partial or complete, of the upper part of the spine, with separation of the articular processes, and tearing of the intervertebral substance. A pure dislocation can only occur in the cervical region, but even then it is not uncommonly associated with a fracture. The reason for this depends partly on the immobility of the dorsal and lumbar vertebræ in the latter regions, and partly on the direction of their articular processes. In the cervical region these look more upwards and downwards, with a slight slope forwards and backwards, so that it is not difficult for one to slip over the other; in the dorsal region they are placed nearly vertical, looking forwards and backwards, whilst in the lumbar they are also vertical, but look inwards and outwards, the lower enclosing the upper as in a sheath, so that in the last two regions of the spine dislocation is impossible without concurrent fracture of the articular processes and probably of the laminæ.

Any part of the cervical region may be the seat of a dislocation. The *occiput* has been displaced from the *atlas* in a few cases, resulting in sudden death; but if incomplete, life has been prolonged for a few hours or days. Dislocation of the *atlas from the axis* has followed blows on the neck, or has been the cause of death in hanging, while the attempt to lift a struggling child by the head has sometimes led to this calamity. In almost all cases the odontoid process has been fractured or the transverse ligament torn, causing instant death from compression of the cord, owing to the head and atlas slipping forwards. Lateral displacement from rotation has also been observed, the symptoms then being of a milder type.

Dislocation may occur between any two of the *lower five vertebræ*, but perhaps most frequently between the fifth and sixth. It is almost invariably the result of forcible flexion of the head on

erhaps combined with rotation, and as a rule the intervertebral rticulations are torn open, whilst the supraspinous and interspinous igaments, the ligamenta subflava, and the anterior and posterior ommon ligaments, are lacerated, and the intervertebral substance om across, or a scale of the articular surface detached. The head nd upper portion of the pine are displaced forwards, so that the cartilaginous surfaces of the articular processes of the lower vertebra project behind the laminæ and transverse processes of the upper, and the lower articular processes of the upper vertebra lie within the intervertebral notch of the lower bone (Fig. 259, A and B, *a*). Two forms of dislocation are met with — the unilateral and bilateral.

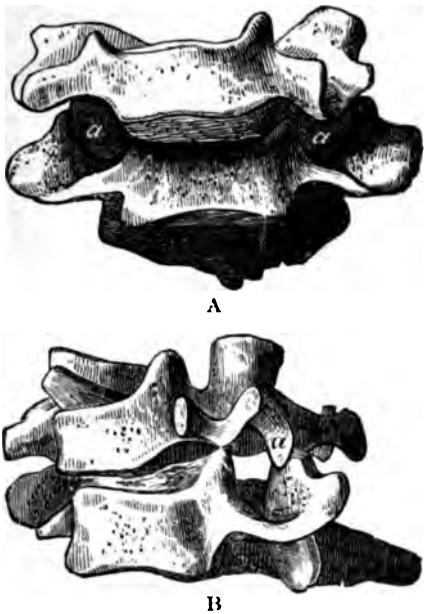


FIG. 259.—DISLOCATION OF THE CERVICAL SPINE. (AFTER KEEN AND WHITE.)

A, As seen from in front; B, side-view; *a*, *a* indicate the lower articular facets of the upper or displaced vertebra, which are thus seen to lie in front of the upper articular processes of the lower vertebra.

(*a*) **Unilateral Dislocation** of the cervical spine is due to force applied from the back and side of the neck. The head is turned towards the opposite side, and more or less fixed, whilst there is no evidence of compression of the cord, although a tingling and neuralgic pain along the course of the nerves may arise from pressure upon and stretching of the nerve roots in the intervertebral notch. The spinous processes may be irregular and displaced laterally, whilst the line of transverse processes is similarly altered; such signs are, however, very difficult to make out in thick necks. If left unreduced, the vertebra becomes fixed in its new position, the head and neck distorted, and permanent neuralgia may result. In such cases, if seen early, *replacement* may be attempted. The patient is anæsthetized, the body fixed, the head and neck flexed, and traction made in that direction, so as to unlock the edges of the articular processes. Reduction may be accomplished with a definite snap or catch. In old-standing cases an operation may sometimes be attempted to relieve pressure on the nerves, but it is impossible to replace the bones.

Bilateral Dislocation (Fig. 259, A and B), if complete, is always accompanied with pressure upon the cord and paraplegia; occasion-

ally, however, it is only partial, and then the cord may escap immediate injury, owing to the large size of the canal in th hæmorrhage and inflammation may subsequently cause gra toms. **Treatment** is of but little avail in most of the case plete double dislocation, since probably the cord is irr damaged; but where paraplegia is incomplete it is pos benefit may arise from early interference. Replacement b on the head with the neck flexed may be first carefully failing that laminectomy should be performed. After stri muscles from the bones, the surgeon will see the two cartilag surfaces of the upper articular processes of the lower vertebr out clearly behind the laminæ of the displaced bone. Upwar on the head may now again be made, and reduction thus a but if this does not succeed, as small a portion as possible of margins of the exposed articular processes is excised in orde of the unlocking of the bones; if the whole processes are reduction is much easier, but Nature's barrier to prevent a r of the trouble has been taken away, and fixation of the spin in its natural position becomes impossible. The sudden pressure not uncommonly causes such an interference with vascular tension in the cervical cord as to lead to a tempor tion of the breathing, for which artificial respiration is req is usually advisable not only to replace the bones, but als the spinal canal and membranes, so as to remove any pr blood or inflammatory exudation which may exist. The such operations are not particularly satisfactory.

Secondary Effects following Spinal Injuries.

Injuries of the spinal column are frequently associated with, or f conditions affecting the cord and its membranes which may lead to results, even when the local lesion to the spine has been comparati These are frequently combined with one another in the most puzzli so that it is often difficult to state the exact nature of a certai symptoms; for simplicity's sake we shall discuss them here without to describe the various combinations which may present themselves.

The following secondary effects may be met with after spinal injuries spinal concussion; (*b*) spinal hæmorrhage; (*c*) spinal meningitis; myelitis; and (*e*) spinal neurasthenia (or railway spine).

Direct Concussion.—This condition may be due to severe blows h which do but little damage to the spinal column, or may be caused b which lead to the infliction of greater mischief, but without any displacement of parts. The term 'concussion' should be limited to *where energetic traumatic influences (falls, blows, collisions, etc.) have given disturbance of the functions of the cord without any considerable visible anato in the latter* (Erb). In fact, the term is really only applicable to those recover more or less completely; if recovery does not ensue, minut tions or other lesions have been present, constituting a condition c rather than concussion. It is somewhat doubtful, however, wheth cases are not due to minute hæmorrhages.

The *Symptoms* produced are those of a more or less complete and loss of function of that portion of the cord situated below the p Thus, a va rying degree of paraplegia is produced, the signs of whic the region affected (see p. 715). In addition, the patient is usual

ral shock to the system, and the reflexes are often totally lost—at any
a time. Death may be caused at once by a blow in the upper cervical
varying degrees of loss of power and sensation may be produced in
ll of the limbs. In the lower cervical region the arms are mainly
nd perhaps some particular nerve may be picked out and paralyzed.
mbar and dorsal regions a more typical paraplegia is produced, with
wer over the sphincters, and loss of reflexes. Priapism never occurs
concussion. The temperature of the body may be depressed, and the
s pallid and cold; the pulse is rapid and weak, and the respirations

gnosis is always uncertain, as in cases where there is no displacement it
ble to gauge the extent of the mischief. If merely concussion is present,
at is likely to recover; if the cord is contused, or hæmorrhage has
into it, a perfect recovery can scarcely be expected.

Treatment, absolute rest to the spine is of the greatest importance, and
ld be maintained if possible in the prone position, so as not only to
static congestion, but also to remove any pressure on the spine, and to
ical applications to be made. A spinal icebag may be applied, or the
be dry-cupped, whilst the patient is kept absolutely still, and on a low
bladder and bowels need attention, but no special drugs are necessary.
, local injuries require suitable treatment.

Hæmorrhage.—We can here only discuss the subject of spinal hæmor-
resulting from injuries. It also occurs apart from traumatism, and it is
g to note that such happens more frequently in young persons between
of ten and twenty than in old people, as with cerebral hæmorrhage.
ling may take place either into the cord itself, or outside it, and hence
llowing varieties are described:

amedullary Hæmorrhage, or spinal apoplexy (*hæmatomyelia*), is met with as
f injury, which need not necessarily involve the spinal column; the lower
egion is the part usually affected, and the type of accident some form of
ion. Extravasation into the cord is rarely extensive, and may occur in
of one clot, usually not larger than an almond, or more commonly in
ts, the gray matter being more or less ploughed up. The white matter
ssed, and sometimes the blood bursts through it into the membranes.
e patient survive the injury for any length of time, secondary degenera-
established, and run the usual course. The patient is suddenly struck
h a more or less complete paraplegia, and with perhaps pain in the back,
round to the chest, and followed by a rapid rise in temperature. Some
recovery follows, especially in the legs, but the parts supplied from the
portion of gray matter—*i.e.*, the arms—are likely to remain paralyzed.
r cases only involving the gray matter, the arms alone may show signs
sis from the first. The *Diagnosis* of hæmorrhage turns on the rapid
paraplegia, which may be incomplete, without spinal irritation; fever
e for a few days, and if the cervical region is affected, extreme con-
of the pupil (myosis) may result from destruction of the cilio-spinal
The *Prognosis* depends on the size and situation of the clot, a large clot
more injury than a small one; hæmorrhage in the cervical region may
diately fatal by interference with the respiration, whilst in the lumbar
is unfavourable on account of the effect upon the sphincter centres.
ok is best when the dorsal portion of the cord is affected. The *Treat-*
e same as was indicated for direct concussion, whilst the administration
nay be beneficial.

ramedullary Hæmorrhage (*hæmatorachis*) is a more frequent complication
injuries, such as sprains or limited fractures, than the former. The
sually extravasated between the bones and the dura mater, especially in
cal region, but may occasionally be found within the dura, having trickled
m the upper part of the column. The symptoms are, in brief, those of
ritation, *e.g.*, pain, hyperæsthesia, spasms, cramps, etc., rapidly followed
f power in the muscles supplied from the damaged area, or by 'gravita-
aplegia (Thorburn), which gradually extends from below upwards,
death by asphyxia, the whole series of phenomena being afebrile. In

tion; later on, lymph or even pus may collect, especially about t
surface of the cord; should the patient live, organization of the ef
may lead to extensive adhesions. *Clinically*, the disease is usually us
a rigor, especially in the septic cases, and then runs a marked pyr
The symptoms are: pain in the back, deep-seated, boring, and sever
on all movements, and often extending down the limbs or aroun
rigidity of the spine and limbs, accompanied by painful cramps a
spasms, almost simulating tetanic convulsions; extreme hyperæsthesi
of the legs, and increased reflex excitability; whilst rapid emaciatic
and sleeplessness is soon produced. If the condition is limited to th
probably followed by signs of myelitis, viz., paraplegia, together w
and vesical troubles, and these may lead to a fatal issue; cases, howe
with which pass into a chronic state, and may more or less recc
process also involves the cerebral membranes, as in septic cases, th
of diffuse cerebral meningitis are also present, and the patient di
Treatment in the cases due to a penetrating injury is of no avail if p
the disease by asepsis fails. In simple cases an icebag should be ap
spine, the patient remaining in the prone position. Ergot and belli
be given internally, and general measures to allay inflammation ad
bladder and rectum must be attended to, and bromides and chloral a
to gain sleep.

(*b*) **Chronic Meningitis** is usually localized, and may occur either as a
tion of the arachnoid and pia mater (leptomeningitis), or be mainly li
dura mater (pachymeningitis). It either originates as a chronic aff
the sequela of an acute attack, and is more likely to supervene i
individuals. The membranes become hyperæmic and thickened, ar
between the cord and its membranes may occur. The extensions of t
into the cord readily explain the fact that a chronic sclerosing
frequently associated with this affection. The *Symptoms* are those
pain and rigidity in the back, increased on all movements, and acco
shooting pains and hyperæsthesia, and perhaps muscular pains and c
reflexes are usually exaggerated, and vesical complications may follow
consists in prolonged rest, with counter-irritation in the form of bli
button cautery applied to the back, whilst mercury is administered in

Spinal Myelitis.—Inflammation of the spinal cord may follow inj
spine, either as a direct consequence of depressed or displaced bo
simple concussion or contusion with hæmorrhage; it may also be
later date by extension of inflammation from the meninges, or result

, much less marked than in acute meningitis. The reflexes vary the amount of destruction of the cord substance, whilst muscular t especially rapid, except in those muscles formerly supplied from the

The sphincters of both bladder and rectum are paralyzed, causing urine and incontinence of fæces; the former is almost invariably septic cystitis, especially when the trophic centres in the lumbar are involved. Bedsores are very liable to be produced, and may extensive and serious. Priapism and hyperpyrexia are often present vical region is affected. The fatal issue is usually due to septic m the urinary tract, or perhaps from the bedsores.

elitis gives rise to a great variety of symptoms, but those most gradually increasing motor weakness, going on to paralysis, together sensory phenomena ending in anæsthesia, whilst there is trouble der and rectum.

ent of each of these conditions is mainly symptomatic.

Traumatic, Neurasthenia (*Syn.:* **Railway Spine, Indirect Concussion** —Cases are not uncommonly met with in which, although there has t injury to the spinal column or cord, and no immediate symptoms , the fact is manifestly demonstrated in various ways that consider- ion and disturbance have been produced in the nervous system. dents are the most common cause of this condition, but it may ıy jar to the spinal column. The reason why railway accidents are nsible for this state is that the forces employed are very great, and unexpected, so that the muscles and ligaments are taken at a dis- ing off their guard, whilst the shock, terror, and mental disturbance rtant factors. Ligamentous and muscular lesions *i.e.*, sprains and he usual local phenomena produced by such accidents.

ority of cases the symptoms are mainly due to excessive irritability of the spinal and cerebral centres, constituting a condition of nerve r **Neurasthenia**, and the history will usually be somewhat of this dividual at the time of the accident is thrown from side to side, or en, but does not lose consciousness, and, although feeling somewhat to alight without help, and may even assist others. He perhaps journey, and goes to his business, but finds in the course of a few s back is painful, his head aching, and that he cannot apply himself

He returns home and goes to bed, sending for his doctor, who will scribe rest and bromides. His condition remains for a time un- omplains of pain and tenderness over certain regions of the spine, lumbar, and is unable to walk, or to undertake any serious mental ffort, whilst all excessive sensory stimuli, such as a bright light or sually disturbing. Neuralgia is often present, whilst the pulse is ine may be retained or may dribble away, and the temperature be for mal. Accommodative asthenopia (or the inability to accommodate cts), resulting in a temporary condition of presbyopia, is also a re in many of these cases. All the symptoms are aggravated by ment and exertion, such as are often produced by the necessary th doctors and solicitors pending the financial compensation by the any. The immediate improvement which often follows the satis- ment of his claim for damages is not necessarily due to imposture, lt from the removal of mental tension and anxiety.

tion of neurasthenia may develop immediately after the accident, condition, the patient lying helpless and prostrate, or more often s in the more common type of cases described above. To it, how- ently added a considerable element of **Hysteria**, in the form either cks of hysterics, or of a chronic unconscious exaggeration of the ptoms. If the patient is examined in the supposed hyperæsthetic is attention is distracted, possibly no pain will be complained of.

sis is generally favourable, the patient recovering in time, but in a permanent effects may be produced.

tment, a good deal of care is needed to judge rightly when the period for encouraging movement rather than rest, and thus to prevent the

looks worn and haggard. Gradually other phenomena develop: power is diminished, and any mental effort causes him to be mudd fails, the temper is irritable, and his sleep disturbed; the head is of vision is usually defective, and he complains of noises in the ears. touch is impaired, so that all delicate movements are hindered. kept rigidly stiff, the head fixed, and the gait is somewhat unsteady ar the walking powers are much diminished, and going up and d especially difficult. Motor power in all regions of the body is pa or every modification of sensation may be met with, whilst the increased. The bladder may lose its power of retaining urine fo this is not always a marked symptom; there is great impairment o desire and power. On examining the back, distinct tenderness is or more spots, especially in the lower cervical, mid-dorsal, and lu In such cases, where the symptoms develop slowly, and remain treatment, the *Prognosis* is most unfavourable, since they are pro inflammatory changes in the cord and brain, and although the pa for years, yet he is permanently crippled, and becomes a confi *Treatment* in the earlier stages consists of rest, preferably on a pron counter-irritation, such as blisters, or even the actual cautery, ov whilst mercury or iodide of potash, and bark, are administered. Ca massage of the limbs, and galvanism, are needed, and warm sea-v may be most useful. If, however, no improvement follows, the pa encouraged to get about as best he can, and to go out in an invali to maintain the general health, whilst careful attention is directed t hygiene.

Paraplegia.

Paraplegia arises in the course of spinal injuries from causes, which may be classified as follows:

1. **Paraplegia arising immediately after the accident, fr**
   - (*a*) Direct concussion without evident lesion, if s dition be possible;
   - (*b*) Disintegration of the cord from intramedull rhage, or from contusion without displaceme
   - (*c*) Displacement of bones, with or without reco the cord;
   - (*d*) Penetrating wounds dividing the cord

(*b*) The pressure of inflammatory exudations, as in spinal meningitis, when the symptoms are preceded by inflammatory phenomena, and do not appear before seventy-two hours at the earliest;

(*c*) The pressure of callus or of cicatricial adhesions around the cord and membranes (*i.e.*, peri-pachymeningitis).

It is unnecessary to discuss further the special signs and symptoms accompanying each form; they have been already mentioned. We merely propose to indicate briefly the effects of a total transverse lesion, and then to describe the results of paraplegia as they vary with the situation of the injury. It must be remembered that the nerves are derived from spinal segments which are always at a higher level than the exit of the nerves from the canal—*i.e.*, the nerves travel downwards within the spinal canal for a variable distance, less in the cervical region, more in the lumbar, before escaping through the intervertebral foramina.

A Total Transverse Lesion, destroying absolutely one segment of the cord, will result in the following symptoms:

1. Paralysis of the muscular area supplied by the destroyed segment, followed by rapid atrophy, reaction of degeneration, and loss of reflexes in this particular group of muscles.

2. Paralysis of all the muscles supplied by the segments below that which has been destroyed. The trophic condition remains normal, at any rate, for a time, but when secondary descending degeneration in the antero-lateral columns has occurred, the muscles become contracted, tense, and rigid (late rigidity). The condition of the reflexes after a total transverse lesion has been a fertile source of discussion, but it is now maintained that the deep reflexes are entirely and permanently lost, whilst the superficial reflexes, though absent for a time, may reappear. If, however, a portion of the cord remains intact, both superficial and deep reflexes may persist or reappear, and even be exaggerated.

3. Complete anæsthesia of the sensitive area supplied by the destroyed segment, and of all the sensitive areas below, and loss of the muscular and thermal senses.

4. A narrow zone of hyperæsthesia is found at the upper level of the anæsthetic area, due to the irritation of the nerve roots at the site of injury.

5. Vasomotor paralysis combined with trophic disturbances in the parts which are paralyzed.

6. Visceral changes, especially in the bladder and rectum.

Phenomena of Paraplegia at Different Levels. 1. **At the Upper End of the Sacrum.**—Total transverse lesions at this spot are exceedingly rare; they only involve the cauda equina and cause paralysis of the sacral plexus. The effects produced are: (i.) Paralysis of all the muscles of the legs, except those supplied by the anterior crural nerve, the obturator, and the superior gluteal, whilst the perineal and penile muscles are also affected. (ii.) Anæsthesia of the penis, scrotum, perineum, lower half of the gluteal region,

muscles of both limbs, including those passing to them trunk; total anæsthesia of the legs, gluteal and perineal re possibly the lower part of the abdomen; whilst, if the vesic are destroyed, there is total paralysis of the bladder, with of the sphincter, dribbling of urine, which early becomes am and cystitis, due to trophic changes; if the centres escape, with overflow is the usual result: the rectum and sphinct paralyzed, causing incontinence of fæces, the passage of wh recognised from the anæsthetic condition of the anus.

3. In the **Mid-dorsal** region the same phenomena are met w them are added a more extensive region of anæsthesia, limi by a hyperæsthetic zone, which feels like a tight painful gi the waist; paralysis of the flat abdominal muscles; re urine, followed by distension with overflow, which, howe asepsis is maintained, may occasionally be followed by reflex micturition in which the patient passes water unc and involuntarily, whenever there is sufficient present to cau stimuli to ascend to the undamaged centres. The abdomina is a most important addition to the gravity of the case, for all movements are thereby prevented, and thus coughing is em and defæcation hindered. The gases developing from the fæces accumulate and cause distension of the belly (meteor thereby respiration may be seriously impaired. The di moreover, is hampered in its action, since the lower ribs fixed or steadied, and hence its contractions tend to pull them instead of increasing the dimensions of the thoracic cavity.

4. In the **Cervico-dorsal** region all these phenomena are pr the anæsthesia extends over nearly the whole trunk, and t æsthesia may involve the arms, whilst the intercostal a muscles are also paralyzed. Respiration has therefore to

Death from Paraplegia, therefore, may arise from a variety of causes and at various periods. It may be immediate, from respiratory failure in lesions above the fourth cervical vertebra; or it may occur from accumulation of mucus or pus in the air-passages, when the lesion is in the upper dorsal region; or it may be delayed for weeks, or even months, and then is due to sloughing of the nates, or septic absorption from an inflamed or ulcerated bladder, which is often associated with suppurative pyelonephritis.

The **Prognosis** and **Treatment** both depend on the position and character of the lesion causing the paraplegia, and on the previous habits and condition of health of the individual.

Laminectomy.

By laminectomy is meant an operation for the removal of the laminæ and spinous processes of one or more vertebræ, in order to relieve pressure on the cord, whether due to depressed bone, abscess, granulation tissue, excessive callus, cicatrices, or tumours. The operation consists in making a longitudinal incision in the middle line of the back, extending to the spinous processes; the muscular and tendinous structures are then cleared from the posterior aspect of the vertebræ as far as the transverse processes, a proceeding usually attended with considerable hæmorrhage, which can be checked, perhaps, better by hot sponge pressure than by attempting to secure the individual vessels. The neural arches are then examined for injury, etc., and those which seem to be most affected removed by cutting pliers, Hey's saw, or laminectomy forceps. The posterior aspect of the membranes of the spinal cord is thus exposed, and the various conditions which may be present are dealt with according to circumstances. In this place we have merely to consider the use of this operation after injury to the spine. For its employment in other conditions see Chapter XXIV.

It must be remembered as a fundamental principle that repair is impossible after the spinal cord has been divided, or any one segment totally disintegrated, and hence, if it is certain that a total transverse lesion of the cord has been caused by an accident, it is absolutely useless to operate. Early and complete disappearance of all the reflexes is a suggestive phenomenon, but cannot be looked on as absolute evidence of a total transverse lesion; if, however, in addition to complete sensory and motor paralysis, the deep reflexes remain absent for any length of time, even though some of the superficial ones have reappeared, operation is useless. The presence of the deep reflexes is always an evidence that at any rate a portion of the cord remains uninjured, and would encourage one to operate. This question cannot, however, be absolutely settled in the early stages of the case, as it is at first impossible to say whether the symptoms are due to concussion, hæmorrhage, or bony pressure. Fortunately, delay does not appear to be so prejudicial to the patient's welfare as one might at first expect, and many cases are on record in which a good result

first lumbar vertebra; the cauda equina is present below and not the spinal cord, and it is reasonable to treat it i way as one would treat a single peripheral nerve; (2) injury is mainly limited to the neural arch, which has bee by direct violence; (3) in all cases of bilateral disloca cervical spine where the patient is not moribund; (4) if arises with or without inflammatory symptoms, when an i elapsed since the accident; the pressure in such cases r duced by blood or inflammatory exudations, and benefit m arise from the operation; if, however, it is due to a total myelitis, no good can follow. (5) When symptoms of i paralysis supervene at a later date, from contraction o around the cord or its membranes (peri-pachymeningiti excessive callus formation, laminectomy may be perfc good hopes of a successful result.

CHAPTER XXIV.

DISEASES OF THE SPINE.

Spina Bifida.

By **Spina Bifida** is meant a condition of imperfect development of some portion of the posterior aspect of the spine, with or without a similar affection of the spinal cord and membranes.

It must be remembered that the spinal cord is developed as a deep involution of the epiblast, the edges of this medullary groove growing up and uniting, so as to include a passage lined with epithelium, and subsequently known as the central canal. The cord is gradually separated from the overlying skin by an intrusion of mesoblastic elements, from which the vertebræ, together with the spinal muscles and ligaments, are developed. The ossification of each vertebra originates in three main centres—one for the body, and one for each half of the neural arch, whilst epiphyses are developed as plates above and below the body, as also for the transverse and spinous processes.

The following are the chief forms of spina bifida:

1. A **Myelocele** results from non-closure of the primitive medullary groove. It is characterized by the appearance in the lumbo-sacral region of a raw surface, which consists of the spread-out structures of the spinal cord, at the upper part of which opens the central canal. The condition is evidently incompatible with life, and the children, if they are not stillborn, as is usually the case, do not live beyond a day or two.

2. A **Syringo-myelocele** (Fig. 260) arises from a distension of the central canal of the cord, the posterior portion of which usually remains adherent to the skin, from which it has never been separated, owing to defective development of the mesoblastic tissues. The spinal nerves travel round the walls of the cyst in order to find their way to the intervertebral foramina. Trophic phenomena are nearly always a prominent feature of these cases.

3. A **Meningo-myelocele** (Fig. 261) is due to a development of fluid within the membranes which remain adherent to the skin, the spinal cord or nerves of the cauda equina passing down the posterior aspect of the cavity as a strap, and the nerves traversing and perforating the sac to reach the intervertebral foramina.

4. A **Meningocele** (Fig. 262) is characterized by a protrusion the membranes, containing cerebro-spinal fluid, through a defect the posterior walls of the vertebræ, the spinal cord and nerves bein in their normal position. This variety is uncommon.

Of these forms, the meningo-myelocele is that most frequent seen in living children, although, according to Bland Sutton, fro whose book on Tumours the above description is mainly derived, t first is really the most common.

Clinical Characters.—A spina bifida is recognised by the appea ance of a tumour in the middle line of the back (Fig. 263), mo commonly involving the lower part of the spine; it may be covere by normal skin, but usually that over the convexity is thin an translucent, and not unfrequently a number of small dilated vesse are seen coursing over it. On compressing the tumour, its size ca

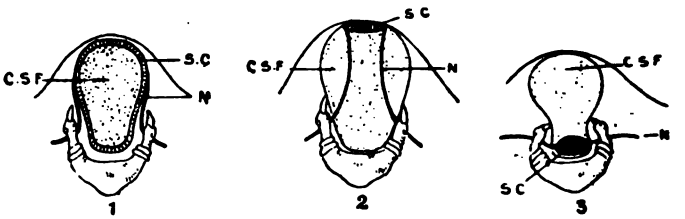


FIG. 260.—DIAGRAM OF SYRINGO-MYELOCELE. FIG. 261.—DIAGRAM OF MENINGO-MYELOCELE. FIG. 262.—DIAGRAM OF MENINGOCELE.

S C, Spinal cord; C S F, cerebro-spinal fluid in sac; N, nerves.

be diminished, and in infants distension of the anterior fontanelle ca be felt, showing that the sac is filled with cerebro-spinal fluid, a there is always a distinct impulse on coughing or crying. The defe in the posterior portion of the vertebræ is very evident, the edges the bones being felt at the margins of the tumour. Various ot deformities may be associated with spina bifida, especially hyd cephalus and talipes, which are perhaps most common in case syringo-myelocele, whilst perforating ulcer, ankylosis of the term phalanges of the toes, and other trophic phenomena, are developed, perhaps at a much later date.

The **Prognosis** of the case depends mainly on the thickness character of the overlying skin. If it is thin, and the cord evi adherent to it, as sometimes indicated by a cicatricial depres dimple, the sac is very likely to give way, causing either death sudden escape of cerebro-spinal fluid, or a fatal issue in a fe from septic meningitis. If the spina bifida is small, and c with healthy skin and subcutaneous tissue, the patient may adult life, but even then trophic phenomena may supervene, as the result of the presence and development of foci of ca tissue, which have been shown to occur in the canal when is absent. Occasionally a meningocele, with only a small

of communication with the spinal canal, is cured spontaneously by the gradual development of the bones constricting the neck of the sac.

Treatment.—The majority of these cases are best left alone, the tumour being merely guarded from injury by the application of a suitable cap. If the sac is gradually increasing in size, and threatening to give way, operative interference is absolutely necessary if life is to be saved. Acupuncture through the thinned integument, the cerebro-spinal fluid being allowed to drain away subsequently into an antiseptic dressing, or tapping through the healthier integument around the base, repeated several times, and followed by compression, may lead to a cure in favourable cases. Statistics, however, go to prove that the best results are obtained by tapping, followed by the injection of Morton's fluid (℞ : iodi, grs. x.; pot. iod., grs. xxx.; glycerinum, ad ℥i.). A small quantity of the cerebro-spinal fluid is withdrawn, and then from half a drachm to a drachm of the iodine solution is introduced. It diffuses itself slowly, and its action is localized, so that if the child is kept quiet, and only semi-recumbent, its effect will be limited to the sac of the spina bifida and its neighbourhood. In some cases persistent leakage may follow this treatment, and such is dealt with by means of a firm antiseptic compress; in many the injection needs to be repeated more than once.

FIG. 203.—SPINA BIFIDA IN A LAD AGED SIXTEEN, PROBABLY OF THE MENINGO-MYELOCELE TYPE. (FROM A PHOTOGRAPH.)

The swelling had not increased much in size since he was a child, but distinct trophic phenomena were being developed in the shape of talipes of both feet.

Of late years treatment by an open operation has been coming more and more into vogue. Naturally, it is chiefly applicable in the meningocele type, and infants or those suffering from trophic phenomena do not stand it well. An incision is made over the sac, either in the middle line if it is certain that the cord is not there, or to one side, if it is. The child should be kept with the head low when the sac is opened, so as to limit, as far as possible, the loss of cerebro spinal fluid. In a meningocele, the protruding membranes are cut away, the wound in them is very carefully sutured, and the spinal muscles drawn together by deep stitches, so as to create an extra protective barrier, in addition to the skin and subcutaneous tissues. When the cord runs down the back of the sac, it is freed by incisions on either side, and if it cannot be separated from the skin, the whole strip is

replaced in the vertebral canal, the membranes are closed ove finally the muscles and skin are united by rows of suture results obtained by this means have been encouraging, and in cases operation may be recommended with some prospect of

Spina Bifida Occulta is the term applied to a condition in w posterior portion of the vertebræ is absent, but without any pr of the cord or its membranes. The overlying skin may be ci in character, or a large growth of hair may arise from it; occa a lipoma develops in this situation, and by its downward compresses the spinal cord, causing paraplegia. Unless condition is present, spina bifida occulta calls for no treatm an exploratory operation should always be undertaken when phenomena supervene.

Congenital Sacral Tumours.

Other congenital conditions of the lower end of the sp described as congenital sacral or coccygeal tumours. The r of these arise from what is known to embryologists as the ne *canal*. In early fœtal life it is supposed that the neural and alin canals are continuous, the passage of communication being kn the above name. Ordinarily, it entirely disappears after th of the proctodeum with the intestine, but evidences of its ex are occasionally met with, either in the form of a cicatricial adherent to the tip of the coccyx (*post-anal dimple*), or as one following conditions:

(i.) A *dermoid cyst*, containing the usual mixture of sel material and epithelial cells, and often a tuft of hair; it deve the space between the rectum and coccyx, and may either posteriorly, below the coccyx, or open into the rectum; the hair may thus find its way out of the anus. In a case under t of Mr. W. Turner, at Westminster Hospital, it was actual nected with the spinal meninges, removal involving the cerebro-spinal fluid.

(ii.) A tumour of a glandular or adenomatous nature is occa found in the same region. It is characterized microscopically existence of alveoli, lined by cuboidal epithelium, held toge connective tissue; it may attain a large size, but is quite in Such growths are termed by Bland Sutton *thyroid-dermoids*, better name would be a *congenital adenoma* of the post-anal gut.

Various other tumours are met with in infants in this regi the same title of congenital sacral or coccygeal tumour has son been applied to them:

(*a*) A *spina bifida* of the meningocele type, which may comm with the subdural space, or may have been shut off by a process of cure.

(*b*) A *lipoma* may also form here, and in some cases has sin by its shape a caudal appendage.

(*c*) A partially developed fœtus may be met with, enclosed the subcutaneous tissues of the sacral region, and known as a t (p. 215).

(*d*) *Sarcoma* and *cystic hygroma* have also been observed.

The conditions are so exceedingly rare that it is unnecessary to enter into details of treatment, which is conducted in accordance with general principles.

Inflammatory Affections of the Spine.

I. **Acute Osteo-myelitis of the Spine** is uncommon. It is due to the same causes as similar disease elsewhere, viz., infection with pyogenic organisms in an individual of low germicidal power. It is characterized by severe pain in a localized portion of the back, and fever; deformity is not a marked feature, since massive necrosis occurs and not a gradually destructive caries. Abscesses form early, and there is great danger of an extension of the inflammation to the spinal meninges, leading to a fatal issue. The prognosis is extremely bad, owing to this latter complication, and the only possible treatment consists in early incisions to give exit to the pus. Sequestra can easily be removed from the back of vertebræ, but from the front only in the lumbar and cervical regions.

II. **Tuberculous Disease of the Spine or Spinal Caries** (*Syn.*: **Pott's Disease, Angular Curvature**).—The above names are applied to a condition due to tuberculous disease of the vertebræ, originating almost invariably in their bodies, which are more or less destroyed, leading to the so-called 'angular curvature.' The term 'Pott's disease' is derived from Percival Pott, who first described it accurately in 1779.

Ætiology.—The causes of tuberculous disease of the spine are much the same as those of tuberculous affections elsewhere, viz.: it affects an individual predisposed to the development of tuberculous disease either by inherited tendency, or by impairment of the general health, as from some preceding illness, or exposure to defective sanitary conditions. The actual deposit of tubercle is probably determined by some injury, such as a strain or sprain of the vertebral column, or of the soft parts attached thereto, which, though slight and perhaps not noticed at the time, is sufficient to cause local diminution of vitality, thereby constituting a favourable nidus in which the *B. tuberculosis* can develop. It is most frequently met with in children, but may arise at any age, and equally in either sex. Any part of the spinal column may be involved, but the lower dorsal is by far the commonest. The cervical region is rarely attacked, except in children, whilst in adults the dorsi-lumbar vertebræ are the favourite seat.

Pathological History.—The actual changes in the bones in Pott's disease are exactly similar in nature to those we have already described as occurring generally in cancellous bone (p. 585). The disease starts in one of two places, either under the periosteum covering the anterior surface of the vertebræ (this most often in adults), or at the line of junction of the upper or lower plate-like epiphyses with the body, the usual situation in children. In the former case the subperiosteal tuberculous deposit early extends to

the subjacent bone, and spreads to neighbouring vertebræ, either along the under surface of the anterior common ligament, or through the intervertebral discs, which are disintegrated by the process. When it spreads along the anterior common ligament (Fig. 264), the disease may be very extensive, body after body being eroded, and the intervertebral discs suffering even more than the bones. In such a case the deformity produced is not angular, but rather of a general kyphotic nature. Occasionally, however, the disease starts simultaneously in many foci, so that the bodies of several vertebræ become pitted and carious, without producing general destruction. In other cases the process is limited to the bodies and intervertebral discs of two adjacent vertebræ, the periosteum being but little affected. This variety is, perhaps, most common in the lumbar region, where the bodies of the vertebræ are large and permit a limiting zone of sclerosed tissue to form; it is also not uncommon in this situation in adults to find definite sequestra (Fig. 265).

FIG. 264.—TUBERCULOUS DISEASE OF SPINE, SHOWING DESTRUCTION OF THE BODIES OF THE VERTEBRÆ, AND ABSCESS FORMATION BENEATH THE ANTERIOR COMMON LIGAMENT. (MODIFIED FROM SPECIMEN IN COLLEGE OF SURGEONS' MUSEUM.)

Cure is effected by the bodies of the vertebræ falling together and becoming ankylosed, so that a deformed and immobile condition of the affected portion of the spine is often the best result that can be anticipated. The new bone thus formed becomes in time sclerosed and very dense, and the synostosis also involves the spines and laminæ. In favourable cases this occurs without suppuration, but not unfrequently abscesses form and add much to the gravity of the condition. Occasionally, the tuberculous process extends backwards through the body of the bone so as to implicate the posterior common ligament, and paralytic or other symptoms may then arise from pressure on the cord.

Rare cases have been described in which the disease mainly affected the sides of the vertebræ, as a result of which lateral deformity occurred: and still more uncommon are those in which the posterior portion of the neural arches is primarily involved.

In the upper cervical region the disease usually starts in the large joints, either between the occiput and atlas, or between the atlas and axis. For a time it may be limited to one side, but usually the bone is attacked at an early stage, and the trouble then spreads to other joints. A special complication of this variety will be mentioned hereafter (p. 731).

The **Signs and Symptoms** produced by tuberculous caries of the vertebræ vary considerably in different situations, but for practical purposes may be described under the following five headings:

1. **Pain** is a constant and invariable accompaniment of the disease, although in the early stages it may not be specially prominent, being only elicited by careful examination. It is of two main types, the local and the referred. *Local pain* is more or less similar in character to that always experienced in disease of bones, although, owing to the cancellous nature of the osseous tissue involved, there is often but little tension, and hence it may be slight. It can, however, be elicited in all cases, either by pressure or percussion over the spines, or perhaps more effectually by pressing upon the transverse processes, so as to induce rotation of the vertebral bodies one on another. Movements of the spine, bending or twisting, are similarly painful, whilst the same result can be brought about by jarring the spine, as by a blow on the head or nates. The old plan of testing for pain by means of a hot sponge applied over the back is comparatively useless in this disease. *Referred pain* is produced by pressure upon, or irritation of, the roots of the nerves as they emerge from the intervertebral foramina; consequently it is always noticed in those parts of the body which are supplied with sensation by the nerves issuing from the spinal canal in the diseased area. If the lumbar region is affected the pain is referred down the legs; in the dorsi-lumbar region it may follow the last dorsal nerve, and be noticed in the lower part of the abdomen, or in the gluteal region; in the lower dorsal region pain is referred to the epigastrium, children who are unable to differentiate its precise nature complaining of 'belly-ache'; in the upper dorsal and lower cervical regions the pain extends into the arms, whilst in the upper cervical region neuralgia follows the course of the cutaneous branches of the cervical nerves. Thus, if the third and fourth cervical

FIG. 265.—TUBERCULOUS DISEASE OF TWO LUMBAR VERTEBRÆ, SHOWING SEQUESTRUM ON THE ANTERIOR ASPECT, AND LATERAL THICKENING PREVENTING ANGULAR DEFORMITY. (COLLEGE OF SURGEONS' MUSEUM.)

nerves are involved, pain is felt along the course of the descending sternal, clavicular and acromial branches; if the second and third are implicated, pain may be confined to the great auricular and occipital nerves; if the atlas and axis are affected, the neuralgic pain, if any, follows the occipital branches.

2. **Rigidity** of the spine is a constant accompaniment of Pott's disease. In the *early* stages it results from muscular spasm, the object being to fix and immobilize the painful part. If the lower portion of the spine is involved, the back is held stiff and straight, the patient abstaining from all movements which would bend or stretch it. Thus, in order to pick up an object from the floor, the knees and hips are flexed, and the patient gradually lets himself down with an absolutely rigid back into a sitting or squatting posture; the

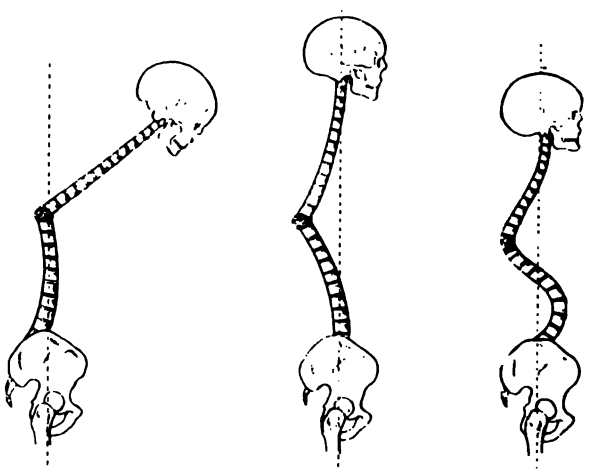


FIG. 266.—DIAGRAMS TO ILLUSTRATE DEFORMITIES IN SPINAL CURVATURE. (AFTER NOBLE SMITH.)

In A the result of the bodies falling together to form a wedge-shaped mass is seen in the anterior displacement of the upper half of the spine; in B the compensatory curves utilized by Nature to maintain the erect posture are indicated; in C the same process is seen in an exaggerated degree.

body is raised in a similar manner by resting the hands upon the thighs, the patient, as it were, climbing with extended arms up his own legs. In a child rigidity in the dorsi-lumbar region can be demonstrated by laying him on his face, grasping the ankles, and ascertaining the amount of movement of the spine at that region by lifting the legs from the table, and also by moving them from side to side. In a healthy child the legs can be elevated, and the spine bent back in the dorsi-lumbar region, nearly to an angle of sixty degrees; whilst lateral mobility to the extent of thirty or forty degrees on either side of the median line is obtainable. When caries is present,

neither of these movements can be made without including the thorax and dorsal spine. In cervical caries the patient steadies the head, and at the same time raises the shoulders by the help of the trapezius and sterno-mastoid muscles, whilst the chin is often supported by one hand, and the patient twists his whole body in order to look sideways.

In the *later* stages, when repair is taking place, or has occurred, rigidity of the spine is due to osseous ankylosis. After a cure has been established, compensatory movements of other portions of the spine mask, to a certain degree, the localized rigidity.

3. **Deformity**, the result of Nature's method of repair by means of osseous ankylosis, is necessarily present in almost all instances, although in a few cases, taken in hand early, it is possible that recovery may occur without it. The amount and character of the deformity depend on a variety of circumstances, and perhaps most of all upon the number of vertebræ affected. Where only two bones are involved, a true angular deformity may result, the body of the upper vertebra being welded to that of the lower, so as to produce a wedge-like mass (Fig. 266, A), the surfaces of which are inclined to one another at an angle; compensatory curves of the spine elsewhere enable the patient to assume the erect posture (Fig. 266, B). In the lumbar region (and to a less extent in the cervical) loss of the normal forward convexity is often the most marked feature, the vertebræ being piled, as it were, one above the other, so as to constitute an absolutely vertical column (Fig. 268). When the affection is limited to two lumbar vertebræ, there is usually little or no displacement, the disease occupying the centres of the bones, so that the sides may escape altogether, and preserve the integrity of the spinal column; if a distinct projection of the spine is present, the portion of bone which appears most prominent is the spinous process of the lower of the vertebræ. Owing to the obliquity and length of the spinous processes of the dorsal vertebræ, the projection, even when only two bones are involved, is very considerable; in the latter case the spinous process of the upper vertebra, by becoming horizontal, is the more prominent. When a large number of dorsal vertebræ are affected, the curvature is never angular, but the whole region becomes bent forwards, and kyphotic in type, or even almost rectangular (Fig. 267). In the cervical region there is rarely much deformity, owing to the small size of the vertebræ, and to the stunted shape and deep position of the spinous processes; if, however, several bones are involved, the head may be carried forwards, together with the upper part of the spine.

FIG. 267.—WELL-MARKED ANGULAR CURVATURE AS A RESULT OF POTT'S DISEASE.

Secondary changes in the shape of the thorax necessarily accompany the more advanced cases of caries in the dorsal region, the sternum becoming convex anteriorly so as to compensate for the diminished vertical measurement of the thorax, and the ribs crowded together to such an extent as to almost obliterate the intercostal spaces. The lower floating ribs may, however, retain their normal position, and thus a horizontal groove may be produced corresponding to the line of the tenth rib. In such cases the patient becomes much stunted in growth and dwarfed, constituting the typical 'hunchback.'

4. **Abscess** is the most serious result of spinal disease, for, owing to its deep origin, it often attains considerable dimensions before it is recognised or treated, whilst it is usually impossible to deal with the causative lesion in the bones, and if once the cavity is allowed to become septic, an exceedingly grave complication is introduced into the case, which may even determine a fatal issue. The pus collects originally on the anterior aspect of the vertebræ, beneath the anterior common ligament (Fig. 264), which may be stripped from the bones for a considerable distance, owing to the tension within the abscess cavity. It thence finds its way to the sides of the bodies after perforating the ligament, and burrows in various directions, according to the portion of the spine involved.

In the cervical region a *chronic retropharyngeal abscess* is first formed; it pushes the posterior pharyngeal wall forwards, and may be detected from the mouth as an elastic fluctuating swelling, which, by its size, often leads to some difficulty in swallowing and breathing, whilst œdema of the glottis may be induced. Left to itself, various courses are open to it: 1. The abscess may burst and discharge into the pharynx, the cavity necessarily becoming septic, and the osseous lesion thus aggravated. 2. It may travel downwards behind the œsophagus into the posterior mediastinum, and thence extend in the same direction as abscesses in the dorsal region. 3. More often the pus finds its way to the side of the neck, being guided to the posterior triangle by the prevertebral fascia, behind which it is situated; less frequently it pierces this fascia, and presents in the anterior triangle. 4. In the lower part of the neck, it may spread under the clavicle into the axilla, being directed by the same fascia, which in this region passes downwards behind the subclavian trunks, and forms the posterior wall of the sheath of the axillary vessels.

In the dorsal region, the abscess starts in the same way in front of the vertebræ, and may thence extend as follows: 1. Most frequently it passes backwards between the vertebral ends of the ribs to form a *dorsal abscess*, burrowing along the course of the posterior branches of the intercostal nerves and arteries, and forming a fluctuating swelling, 3 or 4 inches from the spinous processes, with an impulse on coughing. 2. It may extend between the ribs and the parietal pleura along the anterior branches of the intercostal vessels, coming to the surface at the spot where the lateral cutaneous branches are given off. Tuberculous disease of the ribs, leading to caries or necrosis, or even a localized empyema, may be induced in such cases.

3. Very rarely the abscess may travel up to the neck, pointing behind the sterno-mastoid muscle. 4. Not uncommonly, however, it works its way downwards, passing under the ligamentum arcuatum internum of the diaphragm, thus entering the psoas sheath, and giving rise to a psoas abscess.

In disease of the dorsi-lumbar or lumbar regions, either a lumbar or a psoas abscess may result. A *lumbar abscess* (Fig. 268) is due to the passage backwards of the pus along the posterior branches of the lumbar vessels and nerves to the outer border of the erector spinæ, and usually presents superficially in Petit's triangle — *i.e.*, between the adjacent borders of the latissimus dorsi and external oblique muscles. It there forms a tense fluctuating swelling, with an impulse on coughing. A *psoas abscess* lies within the sheath of the psoas muscle, the pus being usually superficial to the muscular fibres, some of which are probably destroyed. It passes downwards, giving rise to a fusiform enlargement, deeply placed in the back of the abdomen; at the brim of the pelvis, it usually burrows outwards under the fascia iliaca to form a tense rounded swelling in the iliac fossa. It thence travels under Poupart's ligament, behind and external to the common femoral vessels, being constricted at this spot so as to form a narrow neck. The sac then expands behind the common femoral sheath, the vessels being often displaced forwards, and the vein flattened out and compressed. Thence passing along the tendon of the ilio-psoas, to the neighbourhood of the lesser trochanter, the abscess comes into relation with the internal circumflex artery, and usually points at or near to the saphenous opening to the *inner* side of the main vessels. It may, however, follow the different branches of the internal circumflex amongst the adductor muscles, forming a large swelling on the inner side of the thigh, displacing these structures, or it may even travel along its main trunk behind the neck of the femur to reach the surface behind the great trochanter. In other rare cases the abscess has been known to extend down the leg, and has even been evacuated by the side of the tendo Achillis. Occasionally, the pus finds its way down into the pelvis instead of passing under Poupart's

FIG. 268. LUMBAR ABSCESS, RESULTING FROM TUBERCULOUS DISEASE OF THE DORSI-LUMBAR VERTEBRÆ (FROM A PHOTOGRAPH.)

ligament, and then points in the ischio-rectal fossa, or possib burrows through the sacro-sciatic foramen.

The constitutional disturbance associated with the formation these abscesses is usually but slight; perhaps there is a small ri of temperature, but if, as occasionally happens, ordinary pyogen organisms find their way into the sac from within the body, this m become more marked. As they come to the surface, considerat pain may be experienced from the tension and irritation of the sc parts, and fever of a hectic type is induced.

5. **Paraplegia** is fortunately not a common result in tuberculo caries of the spine, only occurring in the worst or in neglected cas It is scarcely ever due to the acuteness of the curve. It has be known to result from a fracture of the spine, the integrity of whi has been weakened by the inflammatory process, but is usual caused by an extension backwards of the disease, so that a nodule button of tuberculous material forms beneath the posterior comm ligament, or pushes through it, compressing the cord against t laminæ, and actually invading the dura mater. It occasional originates in the pressure induced by an abscess, which exten backwards into the spinal canal.

The effect produced on the cord varies with the rapidity a acuteness of the process. When the pressure is rapidly develope a subacute myelitis ensues, but more frequently it is of a chronic sclerosing type. The cord is then found to be constricted or indent by the tuberculous mass, and perhaps considerably reduced in siz its texture is firmer than normal, and the colour grayish. The on of symptoms may be suddenly induced by hæmorrhage or displa ment of bone, but is more usually gradual. The dorsal region (ab the eighth vertebra) is that most often involved, since there is ple of space in the cervical region, and in the lumbar the cord broken up into the cauda equina. Statistics seem to indicate paraplegic phenomena occur in about one out of every thirteen c

The symptoms arising from pressure on the cord must be di guished from those due to irritation of, or pressure on, the r roots. The latter causes neuralgic pain along the course of particular nerve, possibly in the later stages associated with thesia (*anæsthesia dolorosa*), or a limited motor weakness if the an roots are involved. In compression of the cord, motor phen are more evident than sensory, since the sensory track lies tc the centre of the cord, and so is more protected from injur first there is some dragging of the toes on walking, and loss of in the legs, combined usually with neuralgia, weakness sphincters, and exaggeration of the reflexes. Later on the p becomes complete, and, as degeneration of the cord follows, se contractions and rigidity occur, and the reflexes diminish. A incontinence sometimes supervenes, the bladder emptyir periodically and involuntarily, or the urine trickling away co from either a full or empty viscus.

Special mention must be made here of a grave complica

occurring in the upper cervical region, which may result in sudden death. Tuberculous disease of the upper two vertebræ usually originates in one or more of the large articulations on either side of the atlas; if these joints become disorganized, displacement may occur at any moment, and in this way the occiput slips forwards upon the atlas, and may lead to gradual or sudden compression of the cord and consequent death. The disease sometimes spreads to the body of the axis, and by this means the odontoid process becomes detached, or the transverse ligament gives way; in either case, the weight of the head carries the arch of the atlas forwards, and death ensues at once from compression of the medulla.

Course of the Case and Prognosis.—Left to itself, the disease usually progresses more or less steadily, the bone lesion becoming gradually more marked, and abscesses are likely to develop. If treated efficiently, and taken in hand early, repair by ankylosis may be confidently expected. Even when an abscess forms, prolonged rest may lead to its disappearance, the fluid part of the pus being absorbed, and the solid elements becoming inspissated and dry, forming a putty-like mass lying on the front of the vertebral column; this may subsequently break down, probably owing to infection with pyogenic cocci, constituting what is know as a *residual abscess*. Should, however, the abscess burst or be opened, and become septic, symptoms of hectic fever and amyloid disease are almost certain to develop, and the patient is sooner or later exhausted by the discharge, and dies from asthenia. If dealt with judiciously, and sepsis avoided, the abscesses may be cured, and if at the same time the spine is kept at rest, and suitable hygienic measures are adopted, the lesion in the bones is able to consolidate. The onset of paraplegia, again, must not be looked on as rendering the case hopeless, since with prolonged rest the paralytic phenomena often disappear entirely. Septic cystitis and bedsores may arise as complications, and, if allowed to progress, cause the death of the patient. Occasionally, as a result of the implication of the spinal canal, diffuse meningitis follows, leading to a rapidly fatal termination. As in tuberculous disease elsewhere, the patient also runs the risk of acute miliary tuberculosis, whilst other organs, *e.g.*, the lungs, brain, or kidney, may become affected. In spite of these possibilities, however, the prognosis is good as regards life in cases free from complications, and where suitable treatment is practicable.

The **Diagnosis** of spinal caries is never a matter of difficulty when the characteristic deformity exists, but in the early stages, when the displacement is not evident, or if there is only a very slight prominence of the spinous processes, it is likely to be mistaken for a simple rachitic or statical curve; whilst if neuralgic pain is a prominent symptom, it may possibly be looked on as a case of spinal or intercostal neuralgia, or as rheumatism, or even be ascribed to renal affections. Tumours of the spine, such as cancer, or hydatid cysts, syphilitic disease, and aneurismal erosion, also produce symptoms somewhat resembling those of spinal caries, and in adults it may be

from a variety of other causes. (*a*) A ***perinephritic abscess*** is by the association or pre-existence of symptoms of ren whilst a spinal lesion may be absent. Of course, both may be present in the same individual, and the diagnosi only be made by an exploration of the abscess cavity ***empyema*** occasionally points in the loin or even in the should be recognised by an examination of the thora chronic abscess, due to ***appendicitis***, may present very sir to those of a deep-seated abscess in the ilio-psoas region o side, if it has not extended below Poupart's ligament. examination, however, will demonstrate the upward exten abscess towards the spine in the latter case, whilst th history will differ considerably in the two conditions. The of the pus is, moreover, a distinctive element, in that it always an offensive smell when due to appendicitis, on the presence of the *B. coli*. (*d*) An ***iliac abscess*** may a a variety of conditions other than spinal disease, ***e.g.*** or caries of the ilium, or cellulitis in the tissues under iliaca. It is recognised by being, as a rule, more distinc in extent than an ilio-psoas abscess, and by the absence of of spinal disease. (*e*) ***Abscesses arising in connection with*** occasionally point in the groin, but are easily distinguish psoas abscess by not extending upwards along the cou psoas muscle, and by the evident signs of hip disease always present. (*f*) Diffused or ***ruptured aneurism*** of the may give rise to considerable difficulty in diagnosis, si pulsating tumour in the course of the muscle is sometimes The preceding history, the absence of fluctuation, the c congestion of the leg, the interference with the pulse, an increase of the tumour, should indicate the nature of (*g*) The diagnosis of abscess from ***femoral hernia*** is given al

has diminished to such an extent as to warrant the application of a spinal support. In any but the youngest children the prone position on a suitably constructed couch may be adopted with advantage, since by this means the weight of the body is more completely taken off the spine, whilst local applications, such as blisters, or even the actual cautery, can be made. In many cases it is advisable to combine treatment in this fashion with the application of a removable poroplastic or leather spinal jacket. If thought desirable, extension by weight and pulley attached to the legs, as described at p. 542, may also be employed; pain and irritation due to the pressure of the diseased bones one on the other are thereby minimized.

(*b*) *By the Application of Sayre's Plaster Jacket.*—If the disease exists in the dorsal region, the trunk is encased in plaster of Paris, which should extend from the axillæ to just below the iliac crests. The patient is stripped to below the waist, and a closely-knitted woollen vest fitted to the body, and fixed by straps passing over the shoulders. A pad or folded towel is placed beneath it over the abdomen to allow for distension after meals, and in women similar smaller pads may be placed over the mammæ to protect them. Coarse canvas bandages, into the meshes of which plaster of Paris has been rubbed, are thoroughly soaked in water, to which a little salt or alum may be advantageously added, and then wound evenly round the body until a layer of five or six thicknesses is obtained. Over this a paste of plaster of Paris, prepared as described at p. 471, is laid, until the jacket has attained sufficient thickness and consistency. It is allowed to dry before the patient's position is altered. In adults, where the disease is chronic and not acute, the jacket should be applied whilst the spine is extended by suspending the patient by the head and axillæ from a suitably arranged tripod. In children, or when the disease is acute, it will suffice if the parent or an assistant partially supports the patient from the armpits, or the apparatus can even be applied with the child in the recumbent posture. The jacket must be worn until all pain and evidence of active disease have disappeared, and after that the patient should be fitted with a poroplastic support for a time. In disease of the cervical or upper dorsal vertebræ, a special jury-mast is required, in order to steady the head and take the weight off the spine (Fig. 269). It consists of an iron rod, fixed to a plaster or poroplastic jacket, accommodating itself to the curves of the head and neck; above, it extends forwards as far as the vertex, and has attached to its upper end straps, which pass downwards beneath the occiput and under the chin.

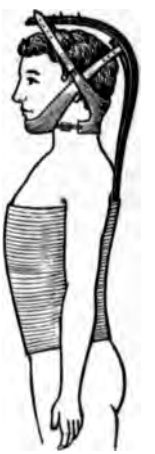


FIG. 269.—SAYRE'S PLASTER JACKET, WITH JURY-MAST FOR CERVICAL DISEASE.

(*c*) *By the Use of Phelps' Box.*—This plan of treatment is recom-

(a) In very young children perhaps the simplest app
double Thomas's splint, with a suitable crutch above
support the head.

During the whole course of treatment, the general con
individual must be carefully attended to, and suitable foo
administered. Wherever possible, the child should be tak
into the open air, or preferably sent to the seaside.
symptoms of pain and irritation have disappeared, the
be allowed gradually to get about again with a mechani
and, indeed, this should not be dispensed with for twe
after apparently complete recovery.

Counter-irritation is but seldom required. It may be
ever, when severe pain exists in the early stages, especiall
The best means to employ is the actual cautery, either
button cautery at several spots on each side of the spine
the skin longitudinally.

Forcible straightening under an anæsthetic has been re
as a means of preventing or correcting the deformity of Pc
A considerable number of cases have now been treated i
and with some degree of success; unfortunately, not a
have been the direct result of this procedure, whilst the
immobilization needs to be very prolonged, or the deformit
Personally we consider that although it may be safe and
straighten the back in a few cases, yet the risks are so gr
process so opposed to Nature's method of cure that u
statistics show much better results than hitherto, the p
scarcely justifiable. The most interesting point observed
nection is the fact that cases of paraplegia seem to be
improved by this process, and that within a few days. It
maintained that no very great degree of force is required t
is desirable; the patient's head and feet are steadied b

A *Retropharyngeal Abscess* should always be dealt with from the neck, as described in Chapter XXIX.

A *Dorsal, Lumbar,* or *Psoas Abscess* should be tapped with a large aseptic trocar and cannula; after the escape of the pus, the cavity is thoroughly washed out with a mild antiseptic lotion, or with sterilized salt solution at a temperature of 105° to 110° F. In the case of a psoas abscess, this irrigation may be combined with gentle massage of the abscess cavity, in order to detach as far as possible the pyogenic membrane, and to assist in the removal of curdy débris. When the lotion returns uncoloured, or but slightly tinged with blood, an ounce or two of a 10 per cent. emulsion of iodoform in glycerine is injected, and diffused, if possible, through the abscess cavity by manipulation. The cannula is then withdrawn, and the external wound closed. Occasionally a cure can be obtained in this way by one tapping, but only when no active disease is present, and when the patient's general health is good; more commonly the fluid will re-collect, and the same process may need to be repeated two or three times. Sometimes the fluid finds its way along the track of the cannula, and a sinus results; such must be dressed antiseptically until cicatrization has occurred. The best position in which to tap a psoas abscess is at a spot just internal to the anterior superior spine; a small incision is made in the skin, sufficient to allow of the insertion of the trocar through the abdominal muscles into the cavity of the abscess, but the surgeon must make certain that the intestines have been previously displaced to one side. In a large abscess no fear need be entertained on this score, since the parietal peritoneum is always pushed inwards; but if there is any doubt, the abdominal muscles must be cleanly divided through an incision about 1½ inches long, so as to expose the abscess sac; a sinus is, however, more likely to form if this is done. Should the abscess point below Poupart's ligament, close to the saphenous opening, it may be necessary to open it there, perhaps in addition to tapping it in the usual place. It must be remembered that the femoral vessels are displaced somewhat and stretched over the sac, and precautions should be taken to prevent puncturing the vein, an accident which has occurred.

Some prefer to open the abscess freely, and scrape out its interior with a Barker's flushing gouge. Certainly by this means the tuberculous membrane and débris can be more thoroughly removed, but the sharp edge of the instrument is capable of doing a considerable amount of harm in this situation, and there is also more likelihood of a sinus remaining. Personally we are not in favour of its use for this purpose, and maintain that the method which we have advocated above is better, since there is less probability of the wound becoming infected with the tuberculous material, and hence of the formation of a sinus.

Occasionally it may seem advisable to freely open the sac of a psoas abscess, and where the disease originates in the lumbar vertebræ, it has been recommended by Sir F. Treves and others to cut down along the outer border of the erector spinæ, and deal with it

be adopted, and the greatest care directed to the steriliz
catheters, septic cystitis being always due to external co
In such cases it would be wise to purify the penis and ure
keep the former wrapped in a dry aseptic dressing in t
between catheterism. A certain amount of forcible exten
permitted in these cases, and will probably do good. L
(p. 717) is required in order to relieve pressure upon the
following cases: (*a*) When septic cystitis or the existe
bedsores is threatening life; (*b*) when, in spite of prolong
symptoms persist or increase; (*c*) when paraplegic sympt
late in the case, and are possibly due to a developme
cicatricial tissue outside the membranes (peri-pachymeni
Finally, whenever the tuberculous process mainly affect
arches, there is no reason for not treating it by operation, i

III. **Syphilitic Disease** of the spine develops in the sh
mata, commencing beneath the periosteum which covers
it is of unfrequent occurrence, and gives rise to symptom
similar to those of tuberculous caries, from which the diag
always easy, apart from the history and its reaction to tre
usually occurs in adults, and is said to mainly affect
vertebræ (Tubby); cases have been recorded in whic
opened into the pharynx, and portions of bone were discha
and expectorated. The co-existence of a syphilitic his
specific lesions elsewhere may help one in coming to a de
the nature of the affection.

Treatment consists in the administration of suitable an
drugs, and in the use of a spinal support.

IV. **Rheumatic Spondylitis** is a condition occasionall
arising from the same causes, and associated with muc
phenomena as rheumatism elsewhere. It may involve
ligamentous or muscular tissues, or may attack the int

The so-called **Gonorrhœal Rheumatism** also affects the spine occasionally, and brings about much the same results.

V. **Osteo-arthritis** sometimes attacks the vertebral column, leading to destruction of the intervertebral discs and of the articular cartilages, together with erosion of the bones and the formation of osteophytic masses around. A large portion, if not the whole, of the spine is usually involved by this disease, and a prominent feature is the almost invariable supervention of ankylosis, either from ossification of the anterior or posterior common ligaments, or from interlocking or fusion of osteophytes. A marked kyphosis results, and great pain is present, sometimes due to pressure of the osteophytes upon the nerve roots. The disease may remain limited to the spine, or may involve other parts of the body. Finally, the process spreads to the articulations between the ribs and the vertebræ, and when these become fixed the respiratory movements are considerably impaired, and hence death is likely to ensue from pulmonary mischief. Treatment is as for similar disease elsewhere.

Tumours of the Spine are usually malignant in character, and most commonly secondary developments of cancer or sarcoma. Simple tumours, such as chondroma, osteoma and hydatid cysts, do occur, as also primary sarcoma. The chief symptoms are severe and localized pain, which is constant, and unrelieved by rest in the recumbent posture, together with early excurvation and paraplegia. Deformity is, however, by no means constant. Neuralgic pain and motor spasms, due to involvement of the nerve roots, may considerably aggravate the patient's sufferings. These phenomena manifesting themselves in an adult should always suggest the presence of a morbid growth, and the more rapid the onset, the more likely is a diagnosis of malignant disease. Treatment necessarily is but rarely feasible, although an exploratory operation is quite justifiable if the disease is primary and the patient not profoundly cachectic.

Tumours of the Spinal Cord and Membranes develop in several situations, and the symptoms are thereby somewhat modified. (*a*) *Outside the spinal dura.* Lipoma and sarcoma are here most often seen, and the symptoms of cord pressure, such as loss of power and sensation, are preceded by those of spinal irritation, *e.g.*, neuralgic pain, increased on movement, and are often limited for some time to one side. Multiple neuro-fibromata of the nerve roots are by no means uncommon. (*b*) They may grow *from the inner aspect of the dura mater*, and thus produce symptoms of cord pressure and meningeal irritation concurrently. Sarcoma, endothelioma, fibroma and gumma, are the commonest forms of neoplasm in this situation. (*c*) *From the spinal cord* itself, myxoma, psammoma, and sarcoma may originate. The symptoms are those of paraplegia combined with some localized and referred pain or tenderness, and either bilateral from the start, or sometimes of the crossed type, anæsthesia being marked on one side of the body, and paralysis and hyperæsthesia on the other, *i.e.*, on the side of the tumour. Left to themselves, patients suffering from any of these growths are certain to die, and hence an exploratory laminectomy, with a view to removal of the growth, if practicable, is always indicated when a diagnosis has been effected. The possibility of the disease being syphilitic in origin must not be overlooked, and hence a preliminary thorough course of iodide of potassium should always be instituted before operating. The results hitherto obtained have been distinctly encouraging, although many of the cases are left till too late, and the mortality is certain to be high.

The only inflammatory disease of the cord which need be alluded to here is one the results of which have already been mentioned constantly in the chapter dealing with the deformities of the body (Chapter XVIII.), viz., **Infantile Paralysis.** This condition is due to an inflammation (probably infective) of the

extensor and adductors are usually picked out. In the arm the d
often paralyzed, and after this the muscles on the extensor side of
excluding the supinator longus. The face and neck are rarely inv
abdominal and back muscles may be attacked. The **Treatment**
stages is directed towards improving the general health, and m
nutrition of the affected muscles as far as possible by electricity an
the later stages, when deformed or weak and flail-like limbs
various means may be adopted in order to improve the function
(*a*) *Mechanical support* is often needed, and this must be carefully
order to assist, and not to hamper, the movements of the individ
necessary weight. In paralytic talipes, irons fixed to the boo
above the knee, or even sometimes running up to the pelvis,
required. (*b*) *Tenotomy*, or division of muscles or fasciæ, may also
certain deformities. (*c*) *Tenoplasty*, or the grafting of a healthy
paralyzed one, has been occasionally utilized, as also the transpla
bony attachments so as to put the relaxed and weak muscles o
(*d*) *Arthrodesis*, or the fixation of joints, is a useful proceeding under
where the unnatural mobility is difficult to control, or would n
siderable increase in the weight of the apparatus required, or w
poverty of the patient, the apparatus cannot be obtained. It
serviceable in cases where two joints in a limb are flail-like, one
then be ankylosed with advantage. The operation consists in
cision, the cartilage alone being sawn or scraped from the ends of
it must always be remembered that the reparative activity in para
small. (*e*) Where the whole limb is hopelessly paralyzed and
venience to the patient, *amputation* is often the best practice.

CHAPTER XXV.

AFFECTIONS OF THE SCALP AND CRANIUM.

Injuries of the Scalp.

Wounds of the scalp are produced by either sharp or blunt instruments, by falls on the head, or by gunshot injuries. From the tenseness of the scalp over the cranium, it often happens that a blunt weapon, such as a policeman's truncheon, will cause a wound nearly as cleanly cut as if it had been made with a sharp instrument. The depth to which the injury extends is a most important element in these cases and, so long as it is limited to those parts superficial to the occipito-frontalis aponeurosis, but little harm is done; if, however, the layer of loose cellular tissue between the aponeurosis and the pericranium (the 'dangerous area') is opened up and infected, cellulitis (p. 74) is likely to ensue, and fatal consequences may result. The superficial extent of the wound is a matter of little moment, since the vascular supply is so good that sloughing is uncommon; a large portion of the scalp may be torn up and bruised, and yet, if it is carefully washed and rendered aseptic, there is every probability that it will retain its vitality.

The **Treatment** of scalp wounds is conducted on exactly the same lines as that of wounds elsewhere; that is to say, after efficient purification they may be stitched up, provision being made for drainage, if necessary. The hair should, of course, be cut away from the neighbourhood of the wound, and an antiseptic dressing applied. Hæmorrhage from the scalp may be severe, owing to the density of the scalp tissues, which prevents contraction and retraction of the divided vessels. For a similar reason it is sometimes difficult to secure them by ligature, and a suture can then be passed under the vessel in such a way as to control it.

Contusions of the scalp may occur without solution of continuity of the surface, and result in the formation of bruises or hæmatomata. A similar condition is found in new-born infants; it is due either to pressure or injury to the head during its passage through the mother's pelvis, or to the compression of obstetric instruments. Three varieties of the so-called *cephal-hæmatoma* have been described, viz.: (*a*) the *Superficial*, which, confined to the dense subcutaneous tissue, is necessarily small and limited. (*b*) The *Subaponeurotic* occupies the

loose tissue under the aponeurosis, and is only limited by the attachments of this structure. It forms a large, soft, fluctuating swelling, upon which the scalp appears to float, bagging down over the eyes or occiput. (*c*) The *Subpericranial* is limited by the pericranium dipping down into the sutures around the bone with which it is connected. Most commonly it forms over one of the parietal bones, presenting a soft, fluctuating swelling, which soon gains an indurated margin owing to a deposit of fibrin, and in this condition may simulate a depressed fracture of the skull, inasmuch as the cup-like fluid centre allows the finger to sink in and touch bone below. It is not difficult to recognise, however, since the indurated margin can be readily indented by the finger, whilst the edge is definitely raised above the surface of the cranium, and hence the sensation of depression of bone felt through the fluid is only apparent. In old-standing cases ossification of the walls of this cavity has even been known to occur. *Treatment.*—All that is required is the application of evaporating lotions. There is hardly ever any need to lay open or drain these swellings.

Diseases of the Scalp.

It would involve a needless amount of repetition to mention and describe in detail all the many conditions which may be met with in the hairy scalp, and therefore it is only necessary to deal with those which are of the greatest importance.

Suppuration is of common occurrence, arising mainly from external infection, but being occasionally due to disease of the subjacent bones. The extent of the abscesses is limited by the same anatomical features as obtain in connection with hæmorrhage. Thus, a *subcutaneous* abscess is necessarily small in size, owing to the density of the tissues in which it is located; it arises most frequently as a result of eczema or impetigo, and is often due to the presence of pediculi, or to the action of irritants used in the cure of ringworm. A *subaponeurotic* abscess usually results from a septic penetrating wound, and is associated with cellulitis. A *subpericranial* abscess is rarely seen except in connection with injury or disease of the bony calvarium; the pus is limited to the affected portion of bone.

Erysipelas and **Cellulitis** have been described elsewhere (pp. 74 and 117).

Tumours occurring in and under the scalp may be considered according to whether they pulsate or not.

I. **Pulsating Tumours of the Scalp** arise from three distinct sources:

1. They may be of *Extracranial* origin, and then are mainly associated with the superficial bloodvessels. (*a*) Ordinary *aneurisms* of traumatic origin are not uncommonly seen; they rarely attain any considerable size, and are readily dealt with by excision. (*b*) *Arterio-venous wounds* give rise either to an aneurismal varix or to a varicose aneurism. They usually involve the temporal trunk, and their symptoms and treatment require no special notice. (*c*) A curious

and tortuous condition of one of the scalp arteries, most often
ıporal, is occasionally seen, and is known as an *arterial varix*;
be treated by complete excision. (*d*) A *nævus* situated over the
r fontanelle may derive a communicated impulse from the sub-
lura. It has no special features apart from this, and is to be
in the same way as other nævi of the scalp, viz., by excision
rolysis. (*e*) A much more serious and interesting phenomenon
ıy of the others is that known as a *cirsoid aneurism*.

id Aneurism is more frequently met with in the scalp than
ere, and mainly involves the temporal region, but may also
in all directions, even downwards into the neck. A tumour
:er or less size is seen under the skin, consisting of distended,
s, pulsating, bluish-looking vessels, the arteries opening
into cavernous spaces without the intervention of capillaries;
sily emptied by pressure, but quickly refills, owing to the
nt arterial supply. The rate of growth is variable, and the
often complains of headache and giddiness; the skin becomes
ıd atrophic, the hair falls out, and finally ulceration may
he patient probably dying from hæmorrhage. The **Treatment**
ently unsatisfactory, complete excision being the ideal cure,
s in the worst cases is impracticable. If it be attempted, the
ıs should be made wide of the disease, and the supplying
secured, if possible, between double ligatures before dividing
if this precaution is not adopted, frightful hæmorrhage may
It is necessary in some cases to deal with the tumour in
:e segments, allowing time between the operations for the
to recover from the loss of blood. Probably *electrolysis*, com-
with ligature of the main nutrient vessels, holds out the best
of success. (For methods of electrolysis, see p. 353.)

'he chief pulsating tumours of *Cranial* origin are as follows:
:comata arising from beneath the pericranium or from the
(p. 747). (*b*) Secondary nodules of cancer may develop in
ploic tissue; those due to the form known as thyroid cancer
:cially noted for their pulsation. (*c*) Aneurism by anastomosis
ınally develops in the cancellous tissue of the diploe, and gives
pulsation, which can be felt when the bones are sufficiently
led and atrophied (p. 610).

'ulsating swellings of *Intracranial* origin include the following
ions: Encephalocele (*vide infra*); traumatic cephal-hydrocele
3); hernia cerebri (p. 795); and sarcoma of the dura mater
').

Non-pulsating Tumours of the Scalp.—Almost any of the
ry connective-tissue or epithelial growths may occur, but the
ng are the more important:

Illomata are not uncommon in the form of small hard warty
wths, giving rise to but little inconvenience, unless situated on
spot where the hat rests. They are easily removed.

Jelioma also occurs, arising either from an irritated papilloma,
ssibly in connection with a sebaceous cyst. As soon as a

rapidly, but are limited for some time by the aponeur occipito-frontalis; glandular infection is uncommon. In th it is useless to attempt to save the aponeurosis; the whol of the scalp must be sacrificed, and the incisions should the growth. The wound is allowed to granulate, or cove Thiersch grafts.

Dermoid Cysts are by no means uncommon in this r favourite situation being near the outer canthus, the ten root of the nose. For a general description, see p. 215. not attain any great size, and may not become evide puberty. The underlying bone is often hollowed out from development of the mesoblastic tissues around them; and a opening may even exist through which a narrow neck pass the cyst into direct connection with the dura mater. T consists in removal; but it is advisable to delay this till af if the tumour seems at all fixed to the skull, or if the bo be defective beneath it, as in such cases the communicati interior of the cranium is often shut off by that time.

Sebaceous Cysts (p. 403) find their most usual situa scalp, where they not only are frequently multiple, bu reach a considerable size. Their removal is best accon transfixion, squeezing out the contents, and picking o wall by a pair of forceps without dissection. The wou by one or two stitches.

Sebaceous Adenoma is most frequently seen on the scal

Affections of the Cranium.

I. **Congenital Affections.**

1. **Meningocele, Encephalocele,** and **Hydrencephalocele** protrusion of the dura mater, with or without part of

cerebro-spinal fluid. It forms a soft, rounded, fluctuating swelling, attached to the skull by a base of greater or less size, and covered by skin, which may be thick and healthy, or thinned, bluish, and translucent when the tumour is large. The vessels present in the skin are often dilated and nævoid. It increases in size and tension on any expiratory effort, such as coughing or crying, and it may be partially reducible, thus allowing the margins of the opening in the cranium to be defined. Symptoms of cerebral compression, convulsions, etc., are likely to be produced by such manipulation. An *Encephalocele* is a similar type of tumour, but contains brain substance, and pulsates nearly synchronously with the heart; it is most commonly situated at the back of the skull. A *Hydrencephalocele*, or Meningo-encephalocele, is a condition in which the tumour contains both brain substance and fluid. Two varieties have been described—one in which there is a small protrusion of the brain associated with an ordinary meningocele, and the other in which the fluid is contained in a cavity communicating with one of the ventricles, and covered by a thin layer of brain substance. They are usually of considerable size, constituting a type of hydrocephalus, and are situated in the occipital region, either above the tentorium, and then possibly associated with distension of the posterior cornu of one of the lateral ventricles, or below that structure, the osseous defect extending in some cases as far as the foramen magnum, and a portion of the cerebellum being within the sac.

FIG. 270.—CONGENITAL ENCEPHALOCELE OF THE OCCIPITAL REGION. (TILLMANNS.)

The **Prognosis** of these conditions is exceedingly grave. Fortunately, many of the subjects are born dead, or die soon after birth. In the more severe cases, idiocy and microcephaly are not uncommonly associated, whilst sometimes true internal hydrocephalus is present. The protrusion may increase steadily in size and finally burst, causing death by purulent meningitis, or in more favourable cases it may remain stationary. In a meningocele, the subsequent growth of the cranial bones may suffice to close the communication between the interior and the tumour, which thus becomes shut off, and remains as a cyst-like swelling, with the base fixed, and without pulsation or respiratory impulse.

Treatment.—Most cases should be left alone; but if the tumour is steadily increasing in size, aseptic puncture and subsequent com-

injuries which otherwise would do but little harm.

3. Localized congenital atrophy of the bones is also somet with in connection with dermoid cysts, as mentioned above.

II. **Acquired Affections** of the skull are atrophic, hyp inflammatory, or neoplastic in nature.

Acquired Atrophy of the skull occurs in many forms:

(*a*) *Craniotabes* is a condition met with during the first ye usually as a result of inherited syphilis (p. 597).

(*b*) *Senile* atrophy may affect the whole cranium, which thinned and rarefied, or it may be localized, as pointed o late Sir G. M. Humphry,* to the parietal bones, constitutir depressions which extend antero-posteriorly. No symp caused thereby, but the patient runs a certain increased injuries to the head.

(*c*) Localized loss of substance may result from the pr tumours, such as Pacchionian bodies and aneurisms, or from or traumatic and operative lesions. If these are at all exte cerebral pulsations can be felt distinctly through the ski then advisable to provide the patient with some guard to pr from injury. This may be accomplished by means of a m worn over the scalp; but of late years operative measures h introduced to obviate this. *Autoplasty* is the term applied ceeding whereby the defect is closed by a plate of bone remo the patient's own skull. A suitable scalp flap is turned d then a portion of the outer table is chiselled up sufficient i close the aperture. The pericranium is utilized on one pedicle, and by means of this it is stitched down into the margins of which have been previously freshened. By *kete* meant a similar proceeding when the hole is closed by a plat platinum, or vulcanite let in under the pericranium or between the dura mater and the cranium. The results of t

plexuses, pressure upon the veins of Galen or inferior longitudinal sinus, and possibly closure of the foramen of Majendie. The head becomes more and more distended, the bones expanded and thinned, and the sutural areas increased, whilst the brain is subjected to such pressure as may be incompatible with life. Fluctuation is distinctly felt, and the bones may crackle under the fingers; the face looks abnormally small, and the eyes protrude, owing to the depression of the orbital plates. *Treatment.*—The ventricles may be tapped at a spot some little distance from the median line, and a considerable amount of the fluid withdrawn, whilst elastic pressure is subsequently maintained; but as the cause cannot be removed, recurrence is almost inevitable. It has recently been demonstrated that there is a direct absorption of fluid into the veins from the subdural space at any tension above the venous pressure, and hence it is suggested that, by establishing a communication between the ventricular and subdural spaces, the excess of fluid in hydrocephalus might be absorbed. This has been attempted in two or three cases, and the results have been encouraging; but of course, to be of any value, it must be undertaken before the cerebral cortex has been so thinned as to interfere with its functional activity.

(*c*) By *Microcephaly* is meant a condition of diminished size of the cranial cavity due to premature ossification of the sutures, and resulting from non-development of the brain. It is usually associated with idiocy, and possibly with cretinism. Attempts have been made to relieve this by the operation of linear craniectomy or removal of portions of the cranium, so as to allow of the expansion of the brain. Temporary improvement has followed in a few cases; but even then the final result is extremely uncertain, most of the patients relapsing owing to the contraction of the dense cicatricial material which replaces the bone, and to the atrophic condition of the brain.

Hypertrophic Changes of the Skull result from simple chronic inflammatory affections, or from injury, etc. We have already alluded to the special types of enlargement seen in inherited syphilis (p. 596), rickets (p. 598), osteitis deformans (p. 603), and acromegaly (p. 605). In leontiasis ossea (p. 816) the cranium also becomes thickened and enlarged; but the cranial cavity is encroached on, constituting what is known as *concentric* hypertrophy, in contrast to most of the other forms, which are *eccentric* in type.

Inflammatory Affections of the Cranial Bones. The cranium is liable to any of the diseases which generally occur in bone.

1. **Acute Periostitis, or Pericranitis**, is usually septic in origin following cellulitis of the scalp; it is likely to result in necrosis of the outer table.

2. **Acute Infective Osteo-myelitis**, or acute necrosis, consists of an acute inflammation of the diploe, due to pyogenic organisms, and either following a septic scalp wound, a compound fracture, or a simple contusion of the bone in a person of low germicidal powers. The symptoms and signs are those generally characteristic of the disease, being ushered in by a rigor, followed by headache, fever,

and the development of a localized œdematous swelling, known as 'Pott's puffy tumour.' The pericranium is stripped up by diffuse suppuration beneath it, and an abscess often forms between the bone and the dura mater. Necrosis of the whole thickness of the skull is likely to follow, extending over the whole bone involved, but usually limited by the sutures. Separation of the sequestrum is *slow*, and accompanied by little or no new formation of bone. Pyæmia and extension of the inflammation to the membranes, venous sinuses or brain, are the chief dangers arising from it. The prognosis is always grave. The *Treatment* consists in free external drainage; but in addition it is necessary to remove the outer table with chisel and mallet to the utmost limits of the disease, and thoroughly to scrape away all the septic diploe, disinfecting the parts beneath with pure carbolic acid. If signs of subcranial suppuration ensue (p. 781), the inner table must also be removed.

3. **Chronic Periostitis** of the cranium is occasionally met with the form of a node. It is usually the result of some long-continued irritation, such as carrying baskets or weights on the head. *Treatment* consists in the removal of the irritation, and there is no objection to chiselling away the node, if necessary.

4. **Tuberculous Disease** of the cranial bones is not common; it occurs as a primary phenomenon, or is secondary either to a cutaneous lesion, such as lupus, or perhaps more commonly to a meningeal focus. It may start in the periosteum or diploe, leading to the formation of a node or perhaps to expansion of the bone, and followed by suppuration and caries. When of meningeal origin there is a considerable amount of erosion of the inner table, and possibly some necrosis; sooner or later the outer table is perforated and a subpericranial abscess forms. The amount of mischief in the outer table is no criterion of the extent of the disease within, and hence very thorough exploration is necessary. The prognosis in this variety is not good. The external orbital margin in the neighbourhood of the external angular process of the frontal bone is rather a favourite situation for the disease, which is then often accompanied by other manifestations.

5. **Syphilitic Disease** of the cranium, on the other hand, is exceedingly common, occurring usually in the tertiary stage, and affecting most frequently the frontal and parietal bones. It has been already described (p. 595).

Tumours of the Cranial Bones.— The chief **Tumours** affecting the calvarium are osteomata and sarcomata.

Osteoma of the cranium occurs as a localized overgrowth of compact bone from the outer surface of the calvarium, from the inner, or from both. The frontal bone and external auditory plate are the sites of election. If arising externally, a smooth, hard globular swelling is produced, hard to the touch, quite painless, attached to the subjacent bone by a broad base; more than one may be present. If the main growth is internal, symptoms of irritation or pressure may be produced. Osteomata of

distinguished from inflammatory hyperostoses (usually of syphilitic origin) by their sharp limitation, absence of pain, and slower progress: whilst osteo-sarcomata are commonly rapid in growth, painful, and of unequal consistency in different parts. *Treatment* is rarely necessary. Small growths may be encircled in the crown of a trephine and thus removed. Large ones must be dealt with by dental engine. No attempt should be made to chisel away these growths, as serious cerebral concussion may follow the prolonged use of the chisel and mallet against the skull.

Sarcoma of the cranium originates either from the pericranium, the diploe, or from the dura mater.

The *extra-* or *peri-cranial* variety consists of a round or spindle-celled tumour growing from the pericranium, and possibly attaining a considerable size. It may contain a certain amount of ossific deposit, or the tumour remains of a soft consistency, and then often ulsates. The subjacent bone is sometimes absorbed, and the dura mater affected secondarily. General infection of the system follows.

Central sarcoma of the cranium starts from the diploe as a myeloid tumour. It does not grow so rapidly as the other forms; it is single, and generally covered with a layer of expanded bone, which gives a sensation of eggshell crackling to the finger. Later on it involves the dura mater and skin, and may fungate.

Sarcoma of the dura mater may be attributed to some injury to the head, and is characterized by the occurrence of severe cerebral symptoms, *e.g.*, intolerable localized headache, epileptic fits, double vision, optic neutritis, etc., prior to any evident appearance of a tumour. Gradually the bones become expanded and perforated, and a soft and exceedingly vascular pulsating growth is felt beneath the scalp. This fungates sooner or later, and possibly the meningeal cavity is laid open by ulceration, death from septic meningitis, cerebral compression, or exhaustion ending the chapter.

Treatment.—These cases have usually gone too far before being recognised. If an early diagnosis can be arrived at, free removal may be undertaken by trephining and the use of the chisel, sharp spoon, or gouge.

III. Traumatic Affections of the Cranium.

Contusions of the Cranial Bones apart from fracture may lead to serious results. 1. Many of the inflammatory conditions of bone just described may be originated; *e.g.*, if the patient is in a condition of low germicidal power, acute osteo-myelitis may follow; or chronic sclerosis and overgrowth of the bone, local or diffuse, may supervene. Syphilitic or tuberculous manifestations may be similarly lighted up if the patient is the subject of either of these diseases. 2. In addition to such osseous conditions, pus may form within the cranium outside the dura mater (*subcranial abscess*, p. 780), and necessitate trephining. 3. The dura mater may be detached by a simple contusion, leading to meningeal hæmorrhage (p. 779). 4. Any of the cerebral lesions detailed hereafter may be produced. Contusions of the cranium

obviously never be treated lightly, even when they are asso-
l with unbroken skin; much more are they serious when com-
ıd, owing to the risks of infection.

ractures of the Skull may be described for convenience under
following headings: *Fissured Fractures of the Vault*; *Fractures o*
Base (usually fissured); and *Depressed or Punctured Fractures.*

1. **Fissured Fractures of the Vault** are always due to externa
ıolence, direct or indirect. In the former case the skull first yield
t the injured spot, but the fissure may extend from it for son
listance; in the latter the fracture results from the yielding of th
skull when compressed beyond its natural limits of elasticity.

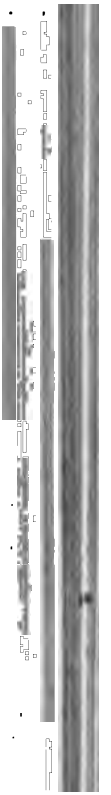
A simple fissure gives rise to no symptoms indicating its presen
with certainty. There may be some amount of superficial ecch
mosis, but nothing more definite. When compound the line
fracture may be seen as a red streak, or even felt with the finger
an irregular ridge. It consists of a mere longitudinal fissure, or n
be starred; if uncomplicated, it is of but little importance, and ne
nothing beyond general treatment—of course, the greatest care b
taken to ensure asepsis. Occasionally, however, an osseous gro
forms from protuberant callus on the inner aspect of the craniur
the site of fracture, and gives rise to traumatic epilepsy or insa
(p. 794).

Traumatic Cephal-hydrocele is the name given to a rare conditio
following simple fractures of the vault, especially in children. It
characterized by the formation of a fluid swelling under the scal
which pulsates synchronously with the heart-beat, and has a defini
impulse on any expiratory effort; it varies in size from time to tim
and is sometimes partially reducible. It contains cerebro-spinal flu
and communicates with either one of the lateral ventricles or
subarachnoid cavity. In one case it was proved on operation t
connected with an arachnoid cyst, due to a localized subarach
hæmorrhage. Probably it is wise to leave this condition
although, if one could be tolerably certain that the ventricle w
affected, it might be laid open and drained.

2. **Fractures of the Base of the Skull** are almost always f
only occasionally punctured or depressed.

Causes.—(*a*) *Violence may be directed to the vertex or to some p*
cranial convexity, as from a blow or fall upon a hard substance
has been a good deal of discussion as to how a fall on t
causes fracture of the base. The old idea of contrecoup
the force was transmitted from one side of the skull to
producing a fracture—may be decently buried and forgo
two main theories still hold the field, each being probably
for a certain number of cases. (i.) Aran's theory of *irra*
tains that a fracture of the base is always due to direct
the fissure from the injured vertex, a proposition proba
in many cases, but insufficient to explain all. (ii.) A
idea, known as the *bursting or compression theory*, is bas
that the cranium is not a solid and totally unimpres

ion of the force where the bulging is greatest (fracture by
on). Inasmuch. however, as the force is transmitted equally
ctions, the weakest and least elastic part is most likely to
, viz., the base. Whether these ideas are justified is a
certainly the figures quoted by Phelps* indicate that
i is responsible for a very large proportion of fractures of
(*b*) *Direct or indirect injury* to the base of the skull is un-
the cause of a certain number of fractures, and some of
depressed, and not fissured, in character. Thus, the point
rella or stick may be thrust through the upper wall of the
p the nose through the cribriform plate of the ethmoid; the
the jaw may be driven through the glenoid cavity into the
ssa by a blow on the chin; direct injury from a fall or a
penetrate the occipital bone, whilst a gunshot wound in the
another illustration of this kind of injury. (*c*) The *impact or*
of the vertebral column against the occipital condyles produces
in the posterior fossa which radiate from the foramen mag-
may even occasion a ring-shaped fracture around it (Fig. 271).
lt from falling on the vertex into a soft mass, *e.g.*, a bale of
y alighting from a height on the heels or nates.
icture may run in any *direction*, longitudinal, oblique, trans-
, according to the direction of the compressing or fracturing
it may affect any part of the base, either being limited to
fossæ or involving all; it may follow the sutural lines in
it is no uncommon thing to see even the dense petrous bone
by a fissure (Fig. 272). Naturally, transverse fractures tend
ited to one of the fossæ, whilst a longitudinal fissure may
em all.
ractures of the base of the skull are simple in nature, but
ity are *compound*. In the anterior fossa the fissure extends
he cribriform plate and nasal mucosa, and then lays open



Fractures of the base of the skull, though very serious, are b means necessarily fatal, and since the introduction of antiseptic t the results have immensely improved. The main *dangers* t apprehended are: (i.) Damage to the base of the brain, including pons and medulla, especially in cases where the foramen magnu splintered from the impact of the spine against the condyles; hæmorrhage arising either from the venous sinuses, or from meningeal or cerebral arteries; and (iii.) septic meningitis, du the fact that the injury not only fractures the bones, but also open the dura mater, a grave addition to a compound fracture.

The **Signs** of a fractured base are sometimes exceedingly equiv but for convenience may be arranged under four heads:

(1) *Signs of severe cerebral mischief*, such as concussion of the b

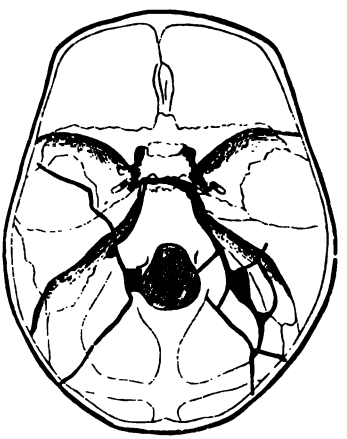


FIG. 271.—FRACTURE OF THE BASE OF THE SKULL FROM FORCE ACTING AGAINST THE OCCIPITAL CONDYLES, AND PRODUCING ALMOST AN ANNULAR FRACTURE AROUND THE FORAMEN MAGNUM. TILLMANNS.)

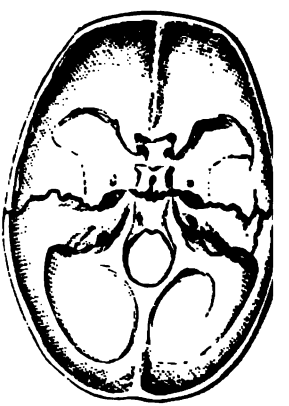


FIG. 272.—TRANSVERSE FR TURE ACROSS THE BASE THE SKULL.

and prolonged unconsciousness. This is, however, by no m always present; thus, in a case we had in hospital some years b the patient was capable of going about his work for ten days t the accident.

(2) *Hæmorrhage* manifests itself in various directions, accordin the situation of the fracture.

In the *anterior fossa* there may be free bleeding from the nose, o to the fracture extending through the cribriform plate of the ethm but a portion of the blood may pass backwards into the pharynx, being swallowed, is perhaps subsequently vomited. More often, h ever, the line of fracture runs across the roof of the orbit, ca escape of blood into the areolar tissue of this cavity. The ecchy shows itself as a gradually developing subcutaneous disten

involving the lower lid, bluish-purple in colour at first, but passing later through the other stages of a bruise; there is probably no contusion of the skin, as in the ordinary black eye, which is at first reddish-purple; the ocular conjunctiva is considerably involved, but the effusion rarely extends above the cornea, and its posterior limits cannot be seen. The bleeding usually arises from laceration of the dura mater and bone, but, when abundant, may come from the cavernous sinus, and the eye may even be pushed forwards (proptosis); in some cases pulsation is to be felt within the orbit, and then a traumatic orbital aneurism or aneurismal varix is present.

In the *middle fossa* the blood may enter the nose or mouth, a part being swallowed, but more commonly it escapes from the ears. If abundant, it probably comes from one of the vascular channels at the base of the brain; but if only slight in amount and of short duration, it may be induced by any of the following lesions, as well as by a fractured base, viz.: (*a*) A simple rupture of the membrana tympani; (*b*) separation of the cartilage of the pinna, with tearing of the lining of the external meatus; (*c*) fracture of the anterior and lower part of the tympanic plate, as by a blow on the jaw, which drives the condyle forcibly against it.

In the *posterior fossa* the bleeding is usually subcutaneous, showing itself around the mastoid process, and extending downwards amongst the muscles at the back of the neck.

(3) *Discharge of cerebro-spinal fluid* is an indication that a communication exists with the subdural space. The fluid may be discharged from one or both ears, but has also been met with coming from the nose or cranial vault; when from the ear, the dura mater has probably been laid open through the prolongation which accompanies the auditory nerve in the internal meatus by a fracture traversing the petrous bone. It is watery and limpid in character, with a specific gravity of about 1,005, slightly alkaline, and containing a fair quantity of chloride of sodium, with traces of albumen, and of a substance which, like grape-sugar, reduces cupric salts on boiling. At first it may be slightly blood-stained, but this soon ceases, the fluid becoming quite clear. The amount discharged may be small, but not unfrequently it comes away in large quantities, soaking the pillow and dressings, and, indeed, can sometimes be caught in a test-tube as it trickles from the meatus. As a rule, the flow commences soon after the injury, and quickly ceases; but a few years back a curious case occurred, under the care of Lord Lister at King's College Hospital, of a man who had fallen backwards off a high bed upon his occiput; he was temporarily stunned, but returned to bed, and, on awaking the next morning, found that both eyes were black. He continued work for ten days, complaining, however, of headache, and at the end of that time of earache, which grew steadily worse, until relieved by something giving way in his left ear. This was followed by a copious discharge of cerebro-spinal fluid, which was maintained for some time, and from the after-history there can be no doubt that it was due to a fractured base.

Escape of brain substance from the ear has also occurred in s instances, most of them fatal.

(4) *Lesions of the nerves* issuing from the base of the skull occasionally produced. For symptoms, etc., see Chapter XV. nerve most commonly involved is the facial, as it passes throug aqueductus Fallopii; the paralysis may develop either immedia or more often about the second or third week after the injury, appearing in about a month, and then evidently due to its imp tion in the callus. A certain amount of deafness is often associ with it from injury to the portio mollis.

The **Prognosis** of fractured base has much improved during re years, as a result of the application of antiseptics to the audi meatus. If the patient escapes death from cerebral complicati the bones of the skull unite rapidly, and a good result may expected, although troublesome sequelæ may follow, from the in sustained by nerves or vessels, or their compression in callu new bone.

Treatment.—Seeing that the chief danger to the patient arises f septic contamination of the meninges, the greatest care mus directed towards preventing decomposition of the discharges. fortunately, it is impossible to apply dressings to the naso-phar or even to wash it out thoroughly with antiseptics, and the satisfaction about such cases is that the rarity of the loss of cere spinal fluid suggests that the membranes of the brain are not often damaged in that situation, whilst it has also been shown in the majority of cases the upper part of the nasal cavity is ase (St. Clair Thomson). With the ear, however, things are different; the meatus should be well syringed with carbolic lo (1 in 20), and lightly packed with some efficient dressing, a large pa the same being bandaged over the affected side of the head. must be replaced as often as necessary. Beyond this, the treatm of fractured base is directed to the cerebral condition, and does differ from that usually applied to head injuries, viz., cold to shaved head (preferably by means of Leiter's tubes), a smart calo purge to start with, low diet, and absolute quiet in a dark ro The patient should be kept from going about his work for at le six weeks.

3. **Depressed and Punctured Fractures** usually involve the va of the cranium, and are due to direct violence, either from a fal blow, causing a simple or compound fracture, or from a penetrat injury occasioning a punctured fracture. In both cases there is o a considerable amount of comminution.

It is quite possible for the outer table to be broken and depres without any injury to the inner, where an air cavity exists in bone, or if the diploe is very thick; thus, the bone may be drive over the frontal sinus without injury to its inner wall, or the mast may be similarly affected. The inner table has also been brok and fragments even separated, as a result of a simple depres without fracture of the outer table; this rarely occurs in adults,

is not uncommon in children. Amongst the latter, it is also possible for a considerable depression to exist without any fracture even of the inner table.

More usually both inner and outer tables are involved, and when such is due to force reaching it from without, the inner table is always more damaged than the outer, especially in the punctured variety (Fig. 273, A and B). When, however, the force is applied from within, as by a bullet which has traversed the brain, the outer table suffers more than the inner. The causes of this condition are similar, from whichever side the force comes; we shall, however, only discuss the case of a wound coming from without. (*a*) The inner table is less supported than the outer, having merely the soft brain and dura mater within, and hence is extensively splintered, just as a nail driven through an unsupported piece of wood causes ripping up of its under surface. (*b*) The loss of momentum of the fracturing body will assist this; the greater the momentum of a bullet, the more cleanly it cuts, a smaller momentum breaking or splintering rather than cutting; of course, a considerable amount of force is expended in penetrating the outer table. (*c*) The débris caused by the injury to the outer table will add to the bulk of the

A

B

FIG. 273.—DEPRESSED FRACTURE OF SKULL SEEN FROM WITHOUT AND FROM WITHIN. (KING'S COLLEGE HOSPITAL MUSEUM.)

penetrating body, and its wedge-like action still further incre injury to the inner table. (*d*) All force tends to radiate an itself from the spot struck, and hence, if the outer table injured, the force will be disseminated over a much wider the inner.

The **Symptoms** and **Signs** arising from a depressed fract widely in their nature, and are partly due to the injury inf the bone, partly to that sustained by the brain, whilst the or not of the wound is of the gravest significance.

Locally, when an external wound is present, one sees l cerebro-spinal fluid escaping, or even brain-substance pro The damage to the bone may be seen or felt, and the exten depression or comminution ascertained. When there is no wound, a hæmatoma of variable size forms under the scalp, less obscuring the fracture. The character of the lesion is of considerable importance from a prognostic point of view. the bone shelves evenly in all directions, a *pond* or *saucer* fra said to be present, and such is tolerably amenable to tre when, however, the depression is sudden and complete, the d portion lying below the level of the rest of the bone, it is t *gutter* fracture, and the prognosis is increasingly grave. T forms are, however, often associated. Necessarily, cons variations are met with in this type of fracture, according nature of the injury and the means by which it was inflicted. if it is due to a fall on the vertex, there is often a ragged, i scalp wound, through which the depression can be seen or caused by the puncture of a sharp tool, such as a pickaxe, only a small external opening corresponding to the hole in th in which the point of the instrument may be found embed slicing cut with a sabre or hatchet produces a clean incision the scalp, together with a linear groove in the skull, perhap what bevelled, which may or may not penetrate its whole th Sometimes detached portions of the skull are raised abo ordinary level, constituting an *elevated* fracture; it is usu sociated with depression of surrounding parts.

Gunshot injuries of the skull manifest any degree of severity, ing to the velocity and angle of incidence of the projectile. penetrating wound produces either a severe localized contus depression with or without comminution. If a modern conica travelling at a high rate of speed, strikes the skull, it will p penetrate, and possibly may traverse both sides and thus doing comparatively little harm, except along its immedia If, however, the bullet is of an expanding type, or if it is tr slowly, it may cause a much more serious lesion.

In a *simple depressed fracture* the patient usually suffers fr cussion, followed almost immediately by compression, the la in part to the depressed bone, but mainly to exudation of bl bruising of the brain, and if this is at all extensive and unrelieved, a fatal result quickly follows. Where, howe

ion is but slight, the symptoms of compression may be absent marked, and the patient recovers, perhaps to become the of traumatic epilepsy or insanity at a later date, induced rritation of the dura mater and of the subjacent cortex. If essed fragments irritate the motor area, convulsions, spasms, ysis may be thereby induced.

ompound depressed or punctured fracture the immediate effects are essarily severe, the patient perhaps not even suffering from on, though brain substance presents in the wound; the more he spot injured, the less the concussion. The explanation of is that the blow has expended its force in fracturing the , and hence does little harm to the brain, in the same way atch may receive but slight damage from a fall if the glass is whilst if the latter remains intact the works are liable to suffer. o itself, such a fracture is sure to become *septic*, and inflamma- he bone, brain, or membranes will follow.

osteitis leads to necrosis of the fragments, which may be ig dead and yellow at the bottom of the wound, whilst the ation may either spread along the diploe to the surrounding using extensive necrosis with pyæmia, or between the bone dura mater, leading to a subcranial abscess.

once the dura mater has been penetrated, inflammation is spread to the meninges, and then a diffuse or localized tive meningitis, accompanied or not with a localized suppura- he brain, will ensue. Even if the dura mater has not been by the injury, the irritation of depressed spicules of bone and ence of a septic exudation often lead to its ulceration at a e. If there is a free external opening, allowing a ready exit lischarge, and thus preventing tension, the process may be ited, and compression of the brain or diffuse septic meningitis ed; but if the bones are locked together as well as depressed, external wound is small, retention of inflammatory products d to their diffusion, and the symptoms of compression will come evident. A hernia cerebri may also form subsequently. the fragments of depressed bone are early removed, even if asepsis is not attained, the patient has a good chance of ; whilst laceration of the dura need not result in menin- ce the opening in the subdural space can be shut off by ns of the arachnoid in a very short time.

an *aseptic* condition of the wound is obtained by early inter- and depressed fragments of bone are successfully elevated or , the prognosis becomes much better, and the case may run mplicated course towards recovery, unless some deeper lesion co-exists.

Treatment of these cases has been much changed by the intro- of antiseptics, the opinion now prevalent being that a patient ater risks from leaving a slight depression unrelieved than by even what may prove to be an unnecessary exploration. The f the operation in all cases is to elevate depressed bone and

to remove sharp edges of fragments which might injure the d
mater. We may epitomize the treatment thus:

(i.) In all punctured fractures, operate.

(ii.) In all compound depressed fractures, operate.

(iii.) In simple depressed fractures: In adults, always operate
children, if gutter-shaped, operate; if pond-shaped, wait for sympt
unless the fracture is a bad one.

The most debatable of these propositions is that relating to
simple depressed fracture in an adult. It may be objected that m
such cases have recovered without operation, and that therefo
shallow depressions one should wait for symptoms; but, wh
admitting the fact, we recall cases where the neglect of such tr
ment has led to serious trouble, and we have been called on
unfrequently to trephine for traumatic epilepsy due to this very
of injury. The operation is so slight, and the risk so insignifi

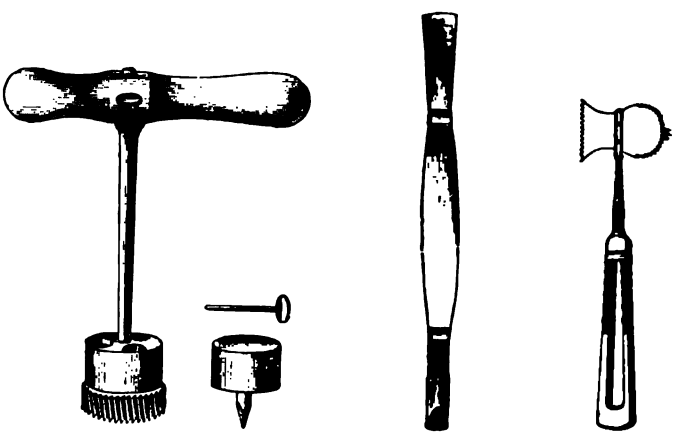


FIG. 274. — INSTRUMENTS USED IN TREPHINING FOR OR ELEVATING A
PRESSED FRACTURE, INCLUDING TREPHINE, ELEVATOR, AND HEY'S S
(DOWN BROTHERS.)

when asepsis is maintained, that the patient should be given
benefit of an exploration, especially since one can never be certa
the amount of injury sustained by the inner table.

When an operation has once been decided on, the sooner
undertaken the better. The scalp should be shaved and thoroug
purified. An anæsthetic may or may not be given, according to
condition of the patient. In a *simple depressed fracture* the sur
should never incise the skin directly over the wound, but al
turn down a flap to avoid the presence of a cicatrix over the l
in the bone. Having cleared away blood-clot and exposed
fracture, some loose fragments may present, and the removal of t
may permit of the introduction of an elevator; if more roo
required, Hoffmann's bone rongeur will suffice to enlarge the ope

no loose fragments, it is sometimes possible to make an sawing off a corner of bone with a Hey's saw. If neither ns is feasible, an opening must be made with a trephine. pin is placed upon some firm undepressed bone as near as possible (Fig. 275), and a circle of bone removed. can now be introduced, the fragments prised up into d the condition of the inner table investigated. Care ken in removing loose ot to tear the dura mater us violence; especially is e when the fracture lies f the venous sinuses. one must be taken away e whole of the damaged examined. The bony away during the opera- be kept in warm boracic line solution, or may be der the flap and thereby When the loss of sub- nall, there is no need to fragments; but when it erable size, it is wise to , wedging them accurately that none lie loose in An opening for drainage between them, if need be. ses they may be chipped all pieces and powdered und.

FIG. 275.—PUNCTURED FRACTURE OF SKULL, SHOWING SPOT FOR APPLICATION OF TREPHINE.

a mater has been injured, tance mixed with blood as soon as the flap is hen the bone has been any protruding portion of terial is removed, and the dura mater lightly stitched gap. The fragments of bone are then replaced as indi-, with a small opening for drainage between them. If ater cannot be closed, an attempt must be made to formation of adhesions between the brain substance perjacent tissues—such a fertile source of traumatic This is best effected by introducing a piece of sterile some similar substance) between the brain and the

und depressed fracture the conditions vary so much that it o give precise indications for treatment. As a general er, the scalp is first shaved and purified; a flap is then as to expose the bony lesion. Loose fragments of bone , and depressed portions elevated in the usual way. It

these cases, but the drainage tube should be removed, if p
forty-eight hours, so as to minimize the chances of hernia

In a *punctured fracture*, although the opening in the bo
small, a large circle is removed, since the inner table
always extensively damaged. The centre-pin should res
bone, as near the opening as possible (Fig. 275), and ca
taken to include all depressed fissures in the field of ope
need be, the dura mater must be opened up and the brain

In all cases the patient should be confined to bed wit
low, and the general rules suitable to head injuries follo
by no means certain that elevation of the depressed bone
the symptoms, as they may be due to hæmorrhagic effusi
brain which cannot be reached.

For treatment of gunshot injuries of the skull, see pp. 2

The symptoms and treatment of the intracranial comp
head injuries are dealt with in the next chapter.

Affections of the Frontal Sinuses.

These sinuses are cavities in the frontal bones lined wit
membrane continuous with that of the nose. They can
said to exist in children, not developing much before
puberty. In adults they vary much in size and shape, an
very asymmetrical; the prominence of the superciliary r
guide to their extent.

Fracture of the anterior wall is not uncommon as the
direct blow, depression of the fragments being produced
out cerebral complications. If the mucous membran
surgical emphysema of the scalp and face may follow, and i
increased on blowing the nose. In compound fractures, s
usually occurs, leading to septic osteitis and necrosis of

ills; in either situation it should be treated by compression, or, ailing this, incision.

Inflammation of the frontal sinus is caused by extension of catarrh om the nose, by penetrating wounds or fractures, by foreign bodies, it may be secondary to disease of neighbouring bones.

Acute Inflammation is usually of a catarrhal type, and produces ontal headache, tenderness and pain on pressure both above and low the eyebrow, and a feeling of dulness or apathy. Constitutional nditions, pyrexia, etc., may also be present. In such cases the rehead should be constantly fomented, and the patient inhales eam from hot water to which eucalyptus and menthol have been lded; rest in bed and suitable purgatives are also necessary.

Acute Suppuration of the sinus is generally traumatic, and then liable to extend into the frontal bone, giving rise to an acute teo-myelitis, which may spread rapidly. The posterior wall of the nuses is extremely thin, so that the membranes of the brain are sily invaded, and an abscess may develop in the frontal lobe. ccasionally extension of mischief to the cavernous or other venous nuses may follow.

The case must be treated by laying the cavity open and draining . For this purpose a curved incision is made along or immediately elow the eyebrow, and the soft parts stripped from the bone, through hich a sufficient opening is made with a gouge close to the middle ne; the pus or mucus is removed, the interior very gently curetted, nd the passage into the nose explored and dilated so as to allow of ree drainage. The cavity is syringed out for some days, and the round usually closes readily, although a fistula occasionally remains. median vertical incision is useful if there is any doubt as to which inus is involved, or if both are affected.

Should acute osteo-myelitis develop, vigorous measures are ecessary. In a case of this type recently under treatment, incisions ere made along each eyebrow from the middle line, and a vertical ne extending from the hair to the root of the nose. The flaps thus ormed were thrown back, the sinuses freely opened, and their nterior walls entirely removed: a large amount of the frontal bone as also taken away until healthy diploe free from purulent infiltra- ion was reached. During the process the posterior wall of the ight sinus was removed, and a large cerebral abscess opened. The patient made a good recovery, although a considerable amount of dead bone had to be subsequently taken away.

Chronic Empyema of the frontal sinus may be the outcome of an acute catarrhal inflammation or may be chronic from the first, extending upwards from the nose. Pus is constantly found in the anterior portion of the middle meatus, and its discharge is not much influenced by the position of the head. Frontal headache is often complained of, and there may be some localized tenderness on pressure. If the infundibulum becomes blocked, the pus may collect and lead to distension of the cavity, the bony walls gradually yielding and thinning before the pressure. A similar condition occasionally results

from distension of the cavity with mucus (*hydrops*). W walls are sufficiently thinned, eggshell-crackling may be not

In the **Treatment** of chronic empyema external operation possible, be avoided, since experience has shown that it is a with a definite mortality, due to acute osteo-myelitis. The i condition is carefully treated; the anterior portion of the turbinal is removed so as to give a better exit to the discha a skilled rhinologist may be able to pass a tube up the infun and wash out the cavity. Should these measures fail to gi and should urgent symptoms appear, then the cavity must b as described above, and a tube passed through into the external wound either being closed at once (Luc), or left a few days and packed with gauze.

The chief **Tumours** growing from the frontal sinuses are cysts or polypi and ivory osteomata; they may also be inv diffuse sarcoma or carcinoma, but the disease is then not li the sinus. The main symptoms and signs result from distu the walls of the cavity, which may yield anteriorly, causing frontal swelling, or the posterior wall is absorbed, leading to compression, or the upper wall of the orbit may be depressed dislocation of the eyeball, and possibly blindness (Fig. 44, Tumours which have attained considerable dimensions ca be removed, death then resulting from cerebral compress occasionally bony masses may necrose, and become loos suppuration around them, and in a few cases they have be away successfully.

CHAPTER XXVI.

AFFECTIONS OF THE BRAIN AND ITS MEMBRANES.

Cranio-Cerebral Topography.

It is scarcely necessary or desirable in a students' manual to deal exhaustively with this subject. The main facts can alone be referred to, and larger text-books of operative surgery or surgical anatomy referred to for further details.*

The *Fissure of Rolando* may be found topographically by the following methods: (*a*) The upper extremity of the fissure corresponds to a point 1 centimetre (or $\frac{2}{5}$ inch) behind the centre of the line extending from the fronto-nasal suture to the external occipital protuberance. The direction of the sulcus is downwards and forwards at an angle of about 67° to the middle line. This may be indicated by laying a half-sheet of letter-paper over the skull, the long side corresponding to the middle line, and with its centre over the upper limit of the fissure; the anterior half is now folded over obliquely from this point, leaving an angle of 45° between the front of the paper and the middle line of the skull; and then the same process is again repeated, bisecting the angle and leaving one of about 67°, so that the anterior limit of the folded paper corresponds to the line of the fissure, which is about $3\frac{3}{4}$ inches in length. A 'Rolandometer,' consisting of two strips of flexible metal united at the appropriate angle, is now sold by many instrument makers. As a general rule this 'Rolandic line' will cross the fissure about its centre, being in front of the fissure above and a little behind it below; but it is sufficiently accurate for practical purposes. (*b*) A less exact method is that defined by Dr. Reid, the measurements for which are all worked from the so-called Reid's base-line, which is one drawn on the skull from the lower margin of the orbit backwards through the centre of the external auditory meatus, reaching the middle line behind just below the occipital protuberance (Fig. 276). From it are drawn upwards two perpendiculars, one (C D) corresponding to the small depression in front of the external auditory meatus, the other (E F) to the posterior border of the mastoid process. The fissure of Rolando

* For a recent review of the relative accuracy of various methods, see a paper by Berry and Shepherd, *Brit. Med. Journ.*, p. 1382, November 19, 1904.

extends from the upper limit of the posterior vertical line to the point where the anterior line intersects the fissure of Sylvius.

To map out the *Fissure of Sylvius*, (1) *Reid* utilizes a line drawn from a point 1¼ inches directly behind the external angular process of the frontal bone (Fig. 276, A), and about the same distance above the zygoma, to a spot ⅜ inch below the most prominent part of the parietal eminence. The undivided portion of the fissure is represented by the first ¾ inch, and from here the anterior limb (*Sy. a. fiss.*) rises vertically upwards for about an inch, whilst the posterior limb extends backwards for the rest of the line. If prolonged to the middle line behind, it indicates with tolerable accuracy the situation of the parieto-occipital fissure (P. O. Fiss.). Careful investigation, however, has shown that no great reliability can be placed on this method.

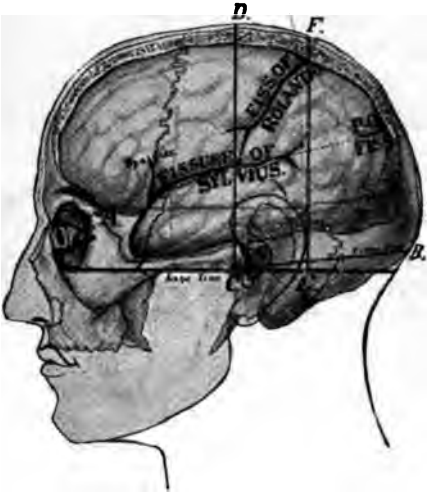


FIG. 276.—DIAGRAM OF HEAD TO INDICATE METHOD OF FINDING THE FISSURES OF ROLANDO AND SYLVIUS BY REID'S METHOD. (AFTER REID.)

Sy. a. fiss., Anterior branch of Sylvian fissure; P. O. Fiss., parieto-occipital fissure; *trans. fiss.*, transverse fissure along line of tentorium; A, external angular process of frontal bone; B, occipital protuberance; C D, anterior perpendicular in front of tragus; E F, posterior perpendicular through back of mastoid process.

(2) Hare and Thane suggest the following measurements, which in the majority of adult skulls may be looked on as substantially accurate. To find the *Sylvian point* (*i.e.*, the point of bifurcation of the suture), a line is drawn horizontally backwards from the fronto-malar suture for a distance of 35 millimetres, and from the posterior end of this a vertical line upwards for 12 millimetres; the upper extremity of this line is the Sylvian point. The posterior limb of the Sylvian fissure is indicated by a line drawn backwards from the fronto-malar suture through the Sylvian point to the lower part of the parietal eminence.

The external limb of the *parieto-occipital fissure* corresponds almost exactly to the lambda.

Professor Chiene of Edinburgh has devised an ingenious and complicated method of topography, but recent investigations indicate that, although it is satisfactory for the Sylvian point and fissure, it is not always to be relied on in other directions, and the plans above

indicated are quite sufficient for practical purposes. After all, when it is a matter of operation, surgeons do not limit themselves to a small trephine opening, but remove considerable portions of the cranium.

Methods of Opening the Cranium.

In the old days but one instrument was employed for this purpose, viz., the trephine; but our increasing knowledge of cerebral lesions and the security given by aseptic methods have necessitated a considerable elaboration in the methods of operating on the cranium.

1. Simple *trephining* is still employed in dealing with many traumatic lesions where an extensive exposure of the brain is not required. The modern trephine (Fig. 274) is usually fitted with a solid metal handle to render sterilization easy, and the crown is usually bevelled and not straight, so as to check the liability to slip inwards and wound the dura. The scalp is incised and turned aside, usually by raising a flap which has its base downwards, so as to ensure its vitality. The pericranium is stripped from the bone, and the trephine applied with the centre-pin projecting. As soon as a well-marked groove has been made, the centre-pin is withdrawn or removed, and the instrument carried through the cranium. An increased flow of blood will often indicate when the diploe is reached, and care must be taken not to injure the dura. To this end the groove in the bone is carefully examined from time to time by a flattened probe or the blunt end of a needle, and the more so when the operation is undertaken in a region where the bone is known to be of irregular thickness. The disc is removed by an elevator (Fig. 274). Considerable bleeding sometimes takes place from the section of the bone, but can usually be controlled by crushing the spot with powerful forceps, or by rubbing in Horsley's wax (carbolic acid, 1 part; oil, 2 parts; wax, 7 parts). If the opening is not sufficiently large, it may be increased by the bone rongeur, Hey's saw or cutting pliers, or even by the trephine.

2. In many cases of cerebral abscess the trephine is unnecessary, as the causative focus (*e.g.*, mastoid disease or frontal sinus empyema) is opened up, and the cranial cavity can then be reached by removing the deeper portions of bone with a gouge. When well inside the skull, a bone rongeur or de Vilbis' punch will suffice to enlarge the opening. Even when the cranium is intact, the gouge is used by some in preference to the trephine to make the first opening.

3. When a considerable area of the brain needs exposure, as in the case of cerebral tumours, various plans are adopted:

(*a*) Some surgeons utilize a large 2-inch trephine, but this is obviously undesirable owing to the irregular thickness of the skull, and the difficulty which necessarily attends the equal deepening of the groove in all directions over such a large circumference.

(*b*) When there is no likelihood of being able to replace the bones, a small trephine hole and enlargement by the rongeur may be relied on.

(*c*) Of late, however, some form of Wagner's osteoplastic method has been chiefly used. In this a flap of scalp tissues is turned down together with the underlying bone, laying bare the dura mater. Some surgeons divide the bone along the line of incision with a chisel and mallet; this is not to be recommended, as the dangers of serious concussion of the brain from such a plan are not to be overlooked. Others use a circular saw; but probably the simplest way is to make four small trephine openings at the corners of the flap, and connect these either by the use of a Hey's saw, or by a Gigli saw (*i.e.*, a piano-wire with a screw-thread turned on it, and with handles attached at each end), passed by means of a probe under the bone from one opening to another, or by the use of a rongeur on two sides, whilst the upper end is sawn through by a Hey's saw set on the slant, so that the incision is bevelled, thereby preventing the bone from slipping in when replaced, and the base is divided by a Gigli saw.

This osteoplastic procedure is a serious one, attended by considerable shock and hæmorrhage, and therefore is often undertaken as a preliminary measure a week or ten days before the lesion in the brain is dealt with.

Lumbar Puncture in the Diagnosis of Cerebral Lesions.

It is a very easy matter to withdraw a quantity of the cerebro-spinal fluid for examination by lumbar puncture. A stout antitoxin or exploring needle should be selected and sterilized by boiling, and the skin in the region of the third and fourth interspaces in the lumbar spine (the spinous process of the fourth vertebra is on a line joining the iliac crests) is to be carefully sterilized as if for a major operation. The point of the needle is then inserted in the middle of the fourth interspace and about a third of an inch from the middle line; it must be pointed forwards, with a very slight inclination inwards and upwards. In most cases it will go straight into the spinal canal below the termination of the cord, and the fluid will escape. If bone is encountered, it is advisable to withdraw the needle completely and re-insert it at a slightly different angle. In cases of repeated failure the third interspace may be tried.

Normal cerebro-spinal fluid is as clear as water, contains a trace of albumen and of a copper-reducing substance, but practically no cells. It escapes drop by drop.

In *acute meningitis*, due to organisms other than the tubercle bacillus, the fluid is turbid and contains much albumen. There are numerous cells present, most of which are polynuclear leucocytes. Bacteria may be detected by suitable methods of staining or by cultures.

In *tuberculous meningitis* the fluid is almost clear, and contains a slight excess of albumen and of cells; the latter are almost all lymphocytes. Tubercle bacilli may be found, but a careful search is necessary. In all varieties of meningitis the fluid is secreted under excessive pressure, and usually issues from the needle in a stream.

In *cerebral abscess* the fluid is normal, but may be under excessive pressure. Lumbar puncture is a most important adjunct in the diagnosis of the intracranial complications of middle-ear disease.

In *fracture of the base of the brain* or of the *spinal column*, blood usually appears in the cerebro-spinal fluid within a few hours of the injury. A small amount of blood from the tissues through which the needle has passed may occur in the first few drops of fluid under any circumstances, and should be discounted; in hæmorrhage the blood is intimately mixed with the fluid.

General Conditions of the Brain after Head Injuries.

Concussion of the Brain, or stunning, is a clinical condition characterized by a more or less complete suspension of its functions as a result of an injury to the head, which results in some commotion of the cerebral substance, and may or may not be associated with hæmorrhage. It varies with the severity of the cause from a slight momentary giddiness and confusion of thought to the most complete insensibility, and is closely allied to shock, from which it is often distinguished with difficulty.

In fatal cases, one finds on post-mortem examination merely the same conditions as obtain in shock, viz., engorgement of the lungs, viscera, and the right side of the heart, whilst the brain presents some lesion of varying severity, from mere punctiform ecchymoses to actual disintegration and disorganization. The symptoms are supposed to be due to a paralysis of the vasomotor centres in the medulla and subsequent loss of vascular tone, allowing the blood to gravitate to the most distensile parts, viz., the portal system. Reflex inhibition of the heart through the vagus may also assist in their production. More recently Duret has suggested that the blow on the skull causes a temporary localized depression of the bone, and this leads to compression of a cone-shaped area of the brain substance. As a result, the cerebro-spinal fluid is displaced and forced downwards to the base of the skull, where it tends to collect, particularly in the fourth ventricle, and thus the vital centres grouped around this space are compressed. This explanation of concussion is very feasible.

The **Symptoms** vary considerably in degree, but in a well-marked case the stage of concussion is evidenced by unconsciousness, more or less complete, although the patient can sometimes be roused by shouting; he lies on his back, with the muscles relaxed and flaccid; the eyelids are closed, and the conjunctiva may be insensitive; the pupils vary, but are equal and often contracted, usually reacting to light; but in bad cases they are dilated, and do not contract when light is admitted. The surface of the body is pale, cold, and clammy, and in severe cases insensitive even to strong electric shocks. The respirations are slow, shallow, and sighing, whilst the pulse is weak, fluttering, and scarcely sensible to the fingers; the temperature is subnormal; the sphincters are relaxed, with perhaps unconscious evacuations from both bladder and bowel. The reflexes are present

in the milder cases, though sluggish; in the more severe they may be entirely absent.

This condition may last for a considerable time, and then pass slowly into more profound unconsciousness and death, or be followed by the phenomena of inflammation, compression, or cerebral irritation. If, however, the case is going on to recovery, *reaction* soon begins to manifest itself. The patient is presumably put to bed, and warmth carefully applied to the extremities. The first sign of reaction is probably a slightly increased rate of both breathing and pulse, whilst he may be able to tell his name and address; sometimes the earliest indication of recovery is that he turns on his side, and pulls the bed-clothes up to his face, since he feels cold and chilly as a result of the cutaneous anæmia. Gradually he becomes more and more rational, and the functions of both mind and body are restored, reaction being fully established by the occurrence of vomiting, due to a condition of cerebral hyperæmia following the anæmia. Probably he suffers from headache for some days, and a slight amount of fever will follow; but this passes off, and leaves the patient either quite well, or with a somewhat irritable brain requiring prolonged rest. Subsequent events may, however, prove that more mischief has been done than appears at first. One sequela of concussion may be that some special function of the brain is permanently lost or impaired, such as memory, hearing, or vision; thus, a patient may forget the names of places or persons, or may lose all memory of time; speech may become defective or stammering, or a certain amount of asthenopia (weakness of vision) may supervene. Such individuals are very liable to recurrent attacks of inflammation, one of which may prove fatal. Others are left with an inordinately irritable brain, incapable of standing excess of work or errors of diet; and in such a sudden fatal issue is not uncommon. Others, again, seem to suffer from a general loss of nerve tone (neurasthenia), rendering them incapable of fulfilling their ordinary duties in life.

The **Treatment** of concussion very closely resembles that of shock, viz., the patient is at once put to bed, with the head low, and is covered with warm blankets; hot-water bottles may be applied to the extremities, and friction to the surface. Any needless stimulation must be avoided for fear of exciting hæmorrhage; an enema of hot coffee may be given, or, if *in extremis*, brandy, or a hypodermic injection of strychnine. A good purge, such as 5 grains of calomel, or a drop or two of croton oil on sugar, should be administered after reaction in the milder cases, but whilst still unconscious in the graver forms, and the patient is then kept for some days in bed on a restricted diet, with the bowels freely open and all sources of excitement excluded.

When the unconsciousness is prolonged, and the absence of signs of fracture of the cranium or of focal symptoms prevents the localising of the lesion, the head should be shaved, and an icebag or Leiter's tubes applied; the bowels are kept acting freely, and the state of the bladder attended to; the room must be kept dark and quiet, the attendants making as little noise in walking and talking, etc., as

possible; sufficient nourishment must be given either by a spoon if the patient can thus take it, or by nutrient enemata or a nasal tube.

Cerebral Irritation.—By cerebral irritation is meant a clinical condition which sometimes follows concussion, characterized by great irritability of both mind and body. It usually results from blows or falls on the temple, forehead, or occiput, and is probably due to a superficial laceration of the brain, possibly in the frontal region, and to the hyperæmia caused by its subsequent repair.

The **Symptoms** are very characteristic, and usually manifest themselves two or three days after the injury. They may be divided into two groups. (*a*) *Bodily Symptoms:* The patient lies on his side in a condition of general flexion, the back arched, the legs drawn up to his abdomen with the knees bent, and the hands and arms drawn in. He is restless, and may toss about, but never fully extends himself or lies supine. The eyes are closely shut, and he resists all attempts to open them; the pupils are contracted; the temperature is usually a little raised, but the surface of the body and head are both cool; the pulse is quiet but weak; the sphincters are usually in a normal condition, and the excreta are often passed in the bed, but the bladder may occasionally need to be emptied by catheter. In some mild instances the patient may get up to empty his bladder and then return to bed. (*b*) *Mental Condition:* The patient is by no means unconscious, but he takes no heed of what is passing around, and is intensely and morbidly irritable. When disturbed, he will gnash his teeth, frown, swear, and resent the intrusion in the most expressive manner. At the end of a few days, or perhaps after a week or two, a marked alteration in the condition of the patient usually shows itself. He is less irritable, begins to stretch himself out, and with this is conjoined an improvement in both pulse and temperature. A change is sometimes noticed in his mental state, since he may be quite childish and weak. 'Irritability gives way to fatuity' (Erichsen). In this stage he may need to be treated as a child, and even taught the names of persons and things; later on he may glibly detail the history and cause of his accident, giving a fresh story every day, but frequently there is an absolute lapse of memory concerning the accident and the events which led to it. After a time the brain recovers, but more or less serious after-effects are likely to ensue. Sometimes the symptoms pass over, however, into those of subacute or chronic meningitis.

In the **Treatment** the surgeon must remember that there is a considerable tendency to asthenia, and hence, while the patient is kept quiet and free from all noise or excitement, he must be well supported by a light and nourishing diet. The head should be placed low and shaved, and Leiter's tubes fitted on, if the patient will permit it; but it is better to omit this entirely than to apply cold intermittently. The bowels must be kept well open, and possibly small doses of bromides, or even opium, may be useful. If any signs of meningeal inflammation follow, such as rise of temperature and pulse, heat of head, and great sleeplessness, blisters or leeches may be applied locally, and mercury administered internally.

cases the symptoms are due more to the associated
inflammation than to the actual cranial lesion. (*b*)
of blood within the cranium, either outside the membr
surface of the brain, or within its substance. If t
extradural, there will probably be a short interval of
between the concussion and the compression; if the bl
bral, the symptoms of compression may manifest then
without any interval being noticed. (*c*) It may be du
spreading œdema, the explanation of which is subs
(p. 771). (*d*) It may arise from a collection of inflam
tion or pus, in which case the symptoms are precede
inflammation, and at the earliest will not manifest the
the third day, whilst they may be deferred for a week

Compression may also arise as a result of idiopathic
tumours, gummata, or abscesses, *e.g.*, as a complicatio
disease.

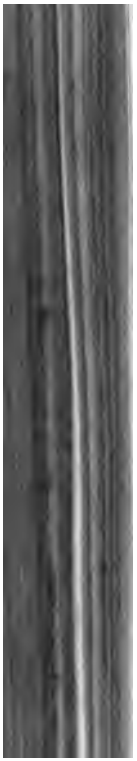
The **Symptoms** of compression are essentially those o
the condition is well established, the patient lies on his b
unconscious, and cannot be roused either by shoutin
His *breathing* is slow, laboured, and stertorous, the li
being puffed in and out. The stertor arises from paral
palate, and the puffing of the cheeks from paralysi
muscles. In the later stages the respirations may be n
irregular, somewhat approaching the Cheyne-Stokes
arises from cessation of the respiratory act. The *pulse* i
at first from irritation of the vagus and vasomotor cen
on becomes rapid and irregular, owing to increased
and exhaustion of these medullary centres. The *surfa*
may either be cool, hot, or perspiring; the body *temper*
varies, in some cases being hyperpyrexial, in others l

later. Thus, it is a common thing to find the pupils unequal
e, and reacting differently to light. The whole body in the
tages is in a condition of *motor paralysis*, but at an earlier period
case there may be some difference on the two sides, if the
is unilateral; thus, if the left side of the brain is primarily
d, a right-sided hemiplegia is likely to be present at a time
he muscles on the left side can still respond to cerebral stimuli.
lized compression involving the motor area may lead to con-
ns in the corresponding group of muscles. The bladder is
zed, and hence retention ensues, whilst the sphincter ani is
d, and fæces pass involuntarily, although marked constipation
lly present.

symptoms in some cases are ushered in by severe pain or
he, which is partly due to pressure upon and tearing of the
mater, and partly to the altered vascular conditions of the
the brain substance itself is not sensitive, and hence the pain
directly referable to any lesion of or pressure upon it.
ally, the clinical picture is modified according to the cause of
mpression, and it is impossible to discuss here more than the
l features. The course of the case, too, varies widely accord-
whether or not the compressing agent can be removed by the
on, or absorbed by natural processes. Patients not un-
only recover from small cerebral and intrameningeal hæmor-
s causing temporary compression, but rarely do so without
tion if the symptoms are due to depressed bone, the presence
oreign body, or large exudations of blood, serum, or pus.

e **Diagnosis** of coma from compression, when a complete history
e case can be obtained, is often easy, and, indeed, the whole
al aspect may be so typical that no question as to the cause of
sciousness can be raised. But when a person is found in the
s unconscious, and no history either of the patient or of an
ent is obtainable, and no serious lesion of the skull is present,
iagnosis is often extremely obscure, since coma may be due to
other causes, *e.g.*: (*a*) Cerebral lesions, such as apoplexy,
her the result of hæmorrhage, embolus, or thrombosis; or it
be the consequence of a preceding epileptic fit, or due to a
lly spreading œdema in cases of cerebral tumour or abscess.
arious toxic agents may induce coma; they may be introduced
the system from without, as in the case of alcohol, opium, or
narcotics, or may be developed within the body, as in uræmia
abetic coma. (*c*) Heatstroke or exposure to cold may also lead
consciousness. In the latter case there can be but little doubt
the cause, since the patient is cold, pale, and in a state of
e prostration; in the former the diagnosis may for a time be
tful. (*d*) Lastly, it must not be forgotten that two or more of
conditions may co-exist. Thus, a drunken man may fall and
k his skull, and then the smell of liquor in his breath may lead
erroneous diagnosis.

is therefore evident that a very careful examination of the patient

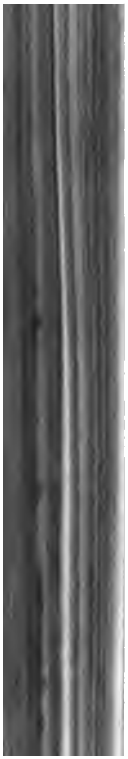


whether or not a fracture is present; the surface tempera
body is noted, as also the character of the pulse and re
The tongue should be looked at, as it is often bitten in a
fit, and the smell of the breath should also be noted. Th
of the pupils may throw some light on the case; in opium
they are small and equal, a condition also seen in hæmo
the pons; in alcoholism they are often dilated and fixe
considerably in different cases. The amount of power an
of the reflexes are then observed, any inequality probably
a unilateral lesion in the brain. The urine must be dra
carefully examined for albumen and sugar. (4) In dub
and especially where there is any suspicion of drunkenness
the stomach should be emptied and washed out. (5) Fi
cause is still uncertain, the patient should be put to bed an
watched.

The **Treatment** of compression must be, where possib
to removing the cause. When it is due to depressed
foreign body, immediate operation is required; collecti
should be opened and blood-clots removed. Failing such
the treatment of the condition resolves itself into keeping
quiet, with the head low and cool, the room dark and no
bowels open (using croton oil on sugar, or enemata, for thi
and the bladder empty. The patient may have to be
rectum, and if the breathing or pulse is very laboured, a
begins to show itself, venesection may be advisable. C
interference with the respiration arises from falling b
tongue, as often occurs in profound anæsthesia duri
operations, and if due to this cause the head may be roll
one side, or the tongue pulled forwards. Occasional
remain in this condition for weeks or months.

I. **Non-penetrating Wounds of the Brain** result from blows and falls, which may or may not produce simple fissured or depressed fractures of the skull, but not unfrequently the most serious cerebral symptoms follow injuries in which the bones do not participate. In depressed fractures the brain is usually most contused or torn immediately below the injured spot; but in cases where there is no depression, the greatest mischief is frequently found at a point exactly opposite to that struck (point of *contrecoup*), whilst the local bruise may be much slighter. Thus, in the case of one of our students who, in an epileptic fit, fell, striking the left occipital region on a stone pavement, we found *post-mortem* a fissured fracture at the spot struck and a bruise on the left occipital convolution, whilst the anterior portion of the right frontal lobe was severely contused, and, indeed, disintegrated. The explanation of this fact is that the force of the injury is transmitted to the brain substance in a wave which concentrates its violence against the opposite side of the skull. In very sharp sudden localized blows, as from a spent bullet, local bruising of the subjacent brain may be alone produced.

Pathological Anatomy.—The *immediate* effects of such an injury vary considerably. There may be a mere bruise, evidenced by a few points of extravasation, on the surface or in the gray matter; or the more superficial parts of the brain may be totally disintegrated and mixed with clots; or, if laceration has occurred, clots may be found adhering to the injured spot, or extending from it widely into the subarachnoid space, or even, under rare circumstances, into the lateral ventricle. The *later* effects in cases where the wound does not communicate with the exterior are mainly those of inflammation or degeneration. Soon after the accident considerable exudation follows, causing the ecchymosed brain substance to swell and become œdematous; this may speedily subside, but in the more serious cases a *spreading œdema* may be caused, owing to the pressure of the swollen tissues upon the superficial veins in the pia mater; the circulation in these is hindered, and increased exudation follows, leading to general cerebral pressure and even death, a consequence hastened by the excess of cerebro-spinal fluid usually induced by the process. Under such circumstances the greater part of the brain is œdematous and glistening, the injured area being yellowish-red in colour, with evident points of extravasation scattered through it. Still later, degeneration of the brain substance may follow owing to the disturbance of its circulation, and is indicated by the presence of a pulpy yellowish mass, soft enough to be washed away by a stream of water, and containing fat globules and granular cells, with débris of nerve fibres (*yellow softening*). If the area involved is small and unimportant, the patient may recover perfectly, the softened tissue being absorbed; if large or implicating important centres, death or paralysis must ensue. In cases of laceration of the brain which recover, a tough depressed cicatrix is formed, usually adherent to the membranes, and containing hæmatoidin crystals, whilst extravasated blood may be organized into a dirty



may, however, persist.

More serious lesions give rise to various symptoms resu hæmorrhagic effusion, and these will manifest themselve once or within twenty-four to forty-eight hours of the inju if the phenomena of compression supervene at once, w interval of consciousness, a diagnosis of depressed bone o hæmorrhage into the cerebral substance may be safely ma the other hand, the patient rallies for a time before the of compression phenomena, an extradural hæmorrhage meningeal vessels or venous sinuses may be suspected, o spreading œdema.

Hæmorrhage into the cortex is characterized by ir paralytic phenomena, which vary with the cortical area The question of unconsciousness depends on the amou hæmorrhagic effusion.

In the *Upper and Middle Frontal Convolutions* neither sensory symptoms are noted, but cerebral irritation and s weak-mindedness are likely to follow, especially if the l seriously involved; lesions to the right frontal lobe do but to a right-handed individual. Apparently, the intellectua are limited to one side of the brain, in the same way as th speech.

Wounds of the *Third Left Frontal Convolutions* lead to moto *i.e.*, the inability to produce or articulate words, in rig individuals; in left-handed people wounds of the right s similar result. Injury to the opposite convolution has no only one side is damaged, the other convolution can after educated so as to take on the function of the damaged regi

Hæmorrhage into *the Motor Area* (Fig. 277) results in convulsions or paralysis, according to the degree of mischi

the head in order, finally becoming general, as in an epileptic fit. After each convulsion the paralysis is found to have spread.

It is sometimes very difficult to diagnose between a true cortical hæmorrhage and one which extends diffusely over the cortex in the subarachnoid space from the rupture of a vein in the pia mater. In the latter, however, the paralysis is less marked and the convulsions less regular, though perhaps more generalized, but the symptoms of compression develop sooner.

Wounds of one *Occipital Lobe* may cause a temporary hemiopia,

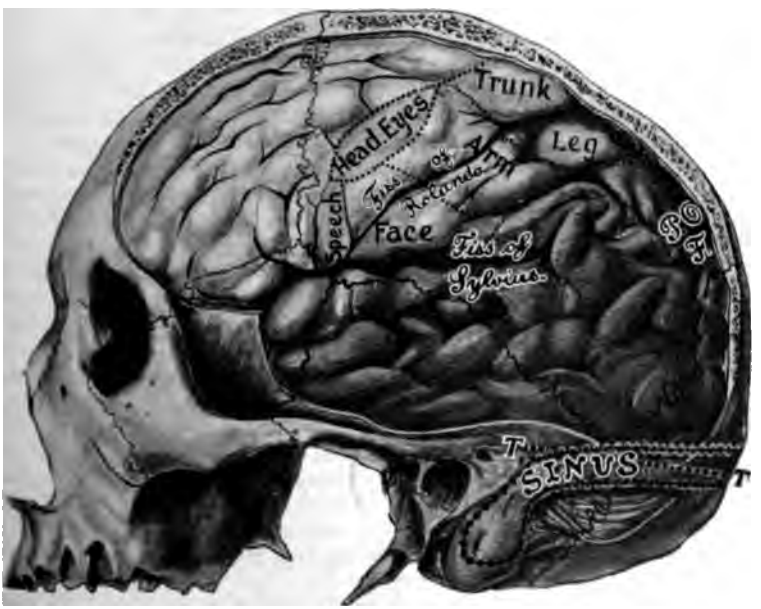


FIG. 277.—ARRANGEMENT OF THE MOTOR CORTICAL CENTRES AROUND THE FISSURE OF ROLANDO IS INDICATED.

P. O. F., Parieto-occipital fissure; T. T., tentorium, below which is seen the cerebellum. The sutural lines of the bones are also visible.

but no persistent loss of vision, unless the angular gyrus is also destroyed. Lesions of the latter region are always associated with permanent disturbances of vision.

The *Upper Temporo-sphenoidal Lobe* contains the cortical auditory centre, and lesions in this region cause deafness: the function of the middle and lower lobes is not yet ascertained with certainty.

Injury to the *Corona Radiata* leads to paralysis of the regions represented by the overlying cortex, but without convulsions or other irritative phenomena. If the corpus striatum or internal capsule is torn or involved in a hæmorrhage coma rapidly supervenes, accom-

panied by hemiplegia and perhaps hemianæsthesia. Occasionally the hæmorrhage bursts *into the lateral ventricle*, and causes a rapid rise of temperature, increasing until the patient's death, together with a very rapid weak pulse and increased respiratory rate (40 to 60 per minute).

Wounds of the *Cerebellum* cause giddiness, vertigo, and ataxy, the patient reeling about in a most characteristic manner, as if drunk.

A wound of the *Crus Cerebri* occasions more or less complete hemiplegia of the opposite side of the body, associated with some amount of hemianæsthesia and total paralysis of the 3rd (oculo-motor) nerve on the side of the injury.

Laceration or contusion of the *Pons Varolii*, if not immediately fatal, may lead to paralysis of the opposite side of the body to the injury, together with paralysis of the 5th, 6th, 7th, or 9th nerves, on the same side as the lesion, constituting the so-called 'crossed paralysis.' Marked contraction of the pupils (myosis) may also be present.

Wounds of the *Medulla* are usually fatal. If, however, the patient should escape, he is liable to suffer from disturbed functions of the circulatory and respiratory centres, with perhaps Cheyne-Stokes respiration and saccharine diabetes.

The **later results** of a cerebral laceration vary much. The patient may recover perfectly after a more or less prolonged period of unconsciousness, but not unfrequently some loss of power persists, which will seriously impair the patient's subsequent usefulness.

The febrile phenomena already mentioned as characteristic of the first few days of convalescence after an attack of concussion may pass into a condition of subacute or chronic localized inflammation of the injured area, as indicated by pain and headache. In such cases the pressure of effusion may be so great as to determine the onset of unconsciousness in four or five days. Occasionally an abscess forms deeply in the white substance, and this will be indicated by the usual phenomena of such a condition, coming on ten or fourteen days after the injury.

The formation of cicatrices between the brain and membranes may determine the development at a later period of traumatic epilepsy or insanity.

The **Treatment** of these cases is always an exceedingly anxious matter for the surgeon. In the majority of instances it is merely symptomatic, following the usual course adopted in concussion, compression, cerebral irritation, etc., as indicated elsewhere. The patient is kept absolutely quiet in bed, with an icebag to the head, and a purge administered. Depressed bone, if present, will, of course, be dealt with by operation. Early convulsions and paralysis are carefully watched to see if any indication as to the site of the bleeding can be obtained, since it is possible that trephining over the injured spot and removing blood-clots or securing bleeding-points might be advisable; but the clinical records as to such treatment are not very encouraging. Late convulsions and paralysis due to inflammation are best treated by shaving the head and applying an ice-cap. If

the pulse is full and hard, and the patient otherwise young and healthy, general venesection may be adopted; the bowels must be moved by a smart purgative, such as croton oil, whilst bromide in full doses may be administered. If the convulsions continue in spite of such treatment, and become more severe and extensive, the patient will almost certainly die of coma; trephining over the injured area is then distinctly indicated, the surgeon hoping to find and remove some clot, or, at any rate, to relieve tension within the dura.

II. **Penetrating Wounds of the Brain** result from blows or falls, as in compound depressed fractures; or from the entrance of foreign bodies, such as bullets; or from stabs or punctures, which most commonly occur in the weaker parts of the cranium, *e.g.*, the temple or upper wall of the orbit; or from sabre-cuts or axe-wounds, in which an oblique or almost valvular incision is made through the scalp and cranium, laying bare and wounding the brain and its membranes.

In these cases the general disturbance is often slight, compared with the extent of the local injury, so that, although brain substance may protrude from the wound, there is sometimes but little concussion. Any of the conditions due to hæmorrhage detailed below may follow, but they may be less severely felt, except in cases where the bleeding is into the substance of the brain, since the blood can escape from the wound. The inflammatory phenomena following such lesions are mainly *septic* in origin, and may be localized or diffuse. In the latter instance general meningo-encephalitis manifests itself in the course of two or three days, and is rapidly fatal; in the former case adhesions prevent the extension of the trouble beyond the neighbourhood of the wound. Hernia cerebri is very likely to follow, and not unfrequently a deep cerebral abscess will complicate matters at a later date. In cases that have been successfully rendered *aseptic*, the course is similar to that run by a non-penetrating wound, except that, if anything, the immediate prognosis is better, since the opening in the skull and the possible removal of damaged brain substance diminishes the likelihood of compression from simple or spreading œdema. Where the lesion has involved the motor area, permanent monoplegia may persist, and traumatic epilepsy is always liable to result owing to the possible formation of cortical adhesions.

The **Symptoms** arising from a penetrating wound of the brain have been in measure indicated above. In the worst cases immediate death may result, or severe concussion, merging quickly into compression, from which the patient never recovers. In the less serious cases there will be a varying degree of concussion, followed after a short interval by the phenomena of inflammation, localized or diffuse, which will be subsequently described. Focal symptoms may also arise from destruction of the cortical centres.

Treatment.—In all cases of punctured or compound depressed fracture, we have stated that a thorough exploration of the wound should be made, and all depressed or injured bone removed. Foreign bodies should be also taken away, if found close to the wound; but

it is doubtful whether a bullet should be sought for, if it has penetrated deeply into the brain, or if it has traversed the brain and fractured the bone on the other side. Probably an aseptic incision, with removal of the splintered fragments and a limited search for the bullet, is the best treatment to adopt, and, even if unsuccessful, will do but little harm, if the patient's general state warrants an operation. When he is evidently moribund, it is better practice not to interfere. Protruding brain tissue is gently removed, and the whole wound thoroughly purified with carbolic lotion; even the 1 in 20 solution may be used without fear. The dura mater should, if possible, be drawn together by one or two sutures, and a small drain-tube or a gauze wick inserted within it. It is often advisable to introduce a portion of sterilized gold foil between the cortex and the dura, so as to prevent the formation of adhesions. Fragments of bone, if kept warm and aseptic, may be replaced (p. 757), and the scalp-wound closed, except at the drain opening; the gauze or tube should be removed, if all is going well, in about two days' time. If the temperature rises as a result of septic infection, the wound must be reopened, and every effort made to relieve tension, and thus localize the mischief. Should diffusion occur, as indicated by an increasing severity of the symptoms, the patient must be treated in accordance with the general principles laid down for dealing with acute meningitis.

In this description of lacerations of the brain we have purposely omitted any mention of the fact that symptoms may arise from inflammatory conditions affecting the bones (p. 745). In actual practice the course of events is often considerably modified by such a complication.

Injuries to the Intracranial Bloodvessels.

1. **Wounds of the Venous Sinuses** are by no means uncommon, being torn across in fractures, or punctured either by some sharp instrument, or by spicules of bone. The superior longitudinal, petrosal, lateral, and cavernous sinuses are those most frequently involved, especially the first, because it is more intimately connected with the bones than any of the others. When there is no external wound, and only the outer wall of the sinus has been opened, the hæmorrhage may strip up the dura mater and compress the brain, producing effects resembling those due to meningeal hæmorrhage; but generally the bleeding is not great, since comparatively little pressure suffices to arrest it by flattening the sinus against the bone. If, however, the inner wall of the sinus is torn across, the blood finds its way between the meninges, and gives rise to the symptoms of diffuse intrameningeal hæmorrhage. When an external wound exists, there is the usual evidence of venous bleeding, but it is readily checked and rarely fatal. Septic thrombosis and pyæmia are the chief dangers, but entrance of air has also led to a fatal issue in a few cases. **Treatment**, when practicable, consists in plugging the sinus

with aseptic gauze, and applying an antiseptic compress, possibly removing fragments of bone in order to expose it. Where the outer wall alone has been torn, it may be possible to suture it without interfering with its continuity. For symptoms and treatment of septic thrombosis, see p. 784.

2. **Wounds of the Middle Meningeal Artery.**—This vessel enters the skull at the foramen spinosum, and subsequently divides into two branches which ramify between the skull and the dura mater. The anterior branch is most frequently injured as it crosses the antero-inferior angle of the parietal bone, as the result of any type of fracture in that locality. The artery is, however, sometimes ruptured by a blow on the side of the head, sufficiently severe to detach the dura mater, but without causing any injury to the bone; this membrane always carries the vessel with it, and if it emerges from a bony canal just at that spot, as so often happens, the artery is torn across by the projecting inner lip of the canal. Whether or not the dura is primarily detached, the blood soon collects between it and the bone, pressing the brain inwards, and burrowing down towards the base of the skull (Fig. 278). Such is due mainly to the force-pump-like action of the arterial pressure, for when fluid is driven into a closed cavity, the power of the jet is multiplied by the area occupied. The clot rarely measures more than 4 inches in diameter. The posterior division is only wounded in about 5 to 10 per cent. of the cases.

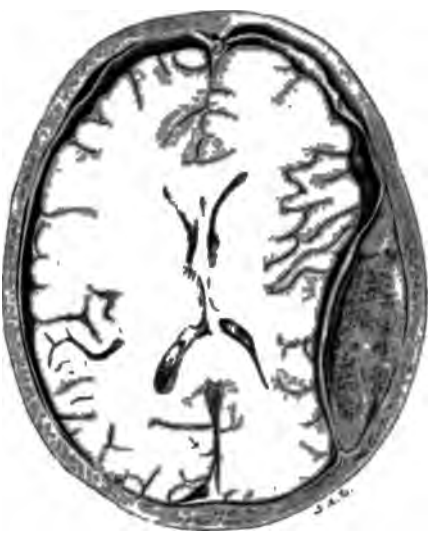


FIG. 278.—MENINGEAL HÆMORRHAGE. (FROM SPECIMEN IN COLLEGE OF SURGEONS' MUSEUM.)

The **Symptoms** are, unfortunately, often obscured by some coexistent cerebral lesion or complication; but in a typical case three stages should be present, viz.: (*a*) A primary concussion, as the result of the blow; (*b*) a temporary return to consciousness; and (*c*) the gradual supervention of coma within twenty-four hours, and that usually without any considerable rise of temperature. The interval of consciousness varies widely, but it is not often longer than an hour or two, whilst in many cases it is scarcely recognisable. As accessory signs, the following may be mentioned: (1) Since the blood-clot is situated close to the motor area of the cortex, and especially over

the centres for the head and arm, twitching of these parts, followed perhaps by paralysis, may be a well-marked feature, and usually supervenes before the onset of coma; (2) when the clot extends to the base of the skull, it presses on the cavernous sinus, and may induce passive congestion of the eyeball, paresis of some of the ocular muscles, and proptosis, with possibly a dilated pupil and high temperature; and (3) when a fissure exists in the bone, blood may filter through into the temporal fossa, and cause a marked fulness in that region. The **Prognosis** is extremely unfavourable, Von Bergmann stating that out of ninety nine cases only sixteen recovered.

The **Diagnosis** of extra-dural hæmorrhage is easy if there is an open wound, or if the symptoms are at all typical; but even then one cannot be certain that the middle meningeal artery has given way, and that the symptoms are not due to venous bleeding. An examination of the injury and of the part struck, and the rapidity of onset of the symptoms, may help in this matter, but it is often impossible to make a diagnosis with certainty.

The **Treatment** consists in trephining in order to remove the blood-clot and secure the artery, if still bleeding. The spot selected for dealing with the anterior division of the artery is 1½ inches behind the external angular process of the frontal bone, and 1½ inches above the zygoma (Fig. 281, F), and this point should be marked on the bone with a bradawl through the scalp before commencing the operation. The scalp is shaved and thoroughly purified, and a flap turned down, including everything as far as the pericranium (Fig. 90, A). A crucial incision is then made over the selected spot, and the pericranium reflected sufficiently to allow a 1-inch trephine to be applied. On removing the disc of bone, a mass of blood-clot presents, which should be broken up with the finger and washed or scraped away. If the artery is seen bleeding on the dura mater, it may be possible to pick it up, and tie or twist it, or a fine curved needle threaded with catgut may be passed under it, and thus a ligature applied. If, however, the blood comes from a canal in the bone, the outer table must be clipped away sufficiently to enable the canal to be seen and plugged by a small piece of aseptic wax, sponge, or gauze, which may be left without danger. The flap is then replaced, and stitched down, a drain-tube being inserted for a time.

The posterior branch of the artery can be reached by trephining immediately below the parietal eminence at the same level as for the anterior branch—*i.e.*, 1½ inches above Reid's base line; or, again, it can be exposed nearer its origin at a spot 1¾ inches behind the external angular process of the frontal bone, and ¼ inch above the upper margin of the zygoma (Fig. 281, G).

3. **Wounds of the Internal Carotid Artery**, in its intracranial portion, are rare, but if complete are necessarily fatal. They usually result from penetrating wounds of the orbit, or from a gunshot wound, or the vessel may be torn by a splinter of bone in a fracture of the base of the skull. Mere fissures through the carotid canal de

little harm, since there is plenty of room within it around the artery. Occasionally, however, the artery is slightly torn, and an aneurismal varix develops between it and the cavernous sinus. Of seventy-five cases of pulsating exophthalmos, Rivington found that forty-one were caused by trauma, and were probably of this nature. **Treatment.**—The injury is fatal in the majority of cases before help can be obtained; if not, compression or ligature of the carotid trunk in the neck is the only hope. See also on intra-orbital aneurism (p. 320).

4. **Intrameningeal Hæmorrhage** arises from wounds of the cerebral cortex or membranes in cases of fractured skull, or from concussion without fracture. The blood may be derived from the veins and capillaries so abundantly present in the pia mater, or from lesions of the inner wall of venous sinuses, or even from the middle meningeal artery, if the dura mater is also opened. It may be widely diffused over the surface of the hemispheres, or be more localized. It is often but slowly absorbed, and may become encapsuled, constituting what is known as an arachnoid cyst—*i.e.*, a closed cavity containing serum, the walls of which are formed of fibrous tissue stained brown with hæmatin.

The **Symptoms** are those of cerebral compression, supervening directly on concussion, though sometimes after a conscious interval. When the bleeding is not very severe, the coma is often of long duration, though, as a rule, not of great intensity. Perfect recovery may ensue, even though unconsciousness is prolonged for weeks; but adhesions may form as the result of a chronic meningitis lighted up by the accident, and these may lead to subsequent trouble. No focal symptoms are produced unless the hæmorrhage arises from or presses upon the motor area, when convulsions, or later on paralysis, may ensue. If, however, the blood escapes from one of the large venous sinuses in the base of the skull, *e.g.*, the cavernous, which may be torn in a fractured base, the patient may pass into a condition of deep coma in a few hours, and may die in a few days.

The **Treatment** is symptomatic, the patient being kept absolutely quiet, and all excitement and noise which might induce cerebral congestion excluded. Should there be any focal symptoms indicating the position of greatest pressure, or should there be some concurrent lesion of the skull, the trephine may be applied at this spot. It must not be forgotten, however, that the chief hæmorrhage often occurs, not at the point to which the injury was directed, but at an exactly opposite spot on the other side of the cranium, and hence considerable uncertainty may arise both as to the advisability of an operation and as to its site. Should the right locality have been exposed, the dura mater will probably bulge into the wound, after the circle of bone has been removed; it is blackish blue in colour, owing to the clot lying beneath it, and the cerebral pulsations will not be detected. It is carefully incised, and the blood-clot removed; any bleeding-points should be tied or compressed, or it may be necessary to insert a small wick of aseptic gauze for a day or two, in order to drain off serum and blood.

5. **Cerebral Hæmorrhage** occurs more frequently from idiopat causes than from trauma, except in the case of severe laceratic In the more aggravated forms, death is almost certain to follow a short time from coma.

Intracranial Inflammation.

Inflammation of the cranial contents is almost always bacterial origin, and may follow a great variety of lesions, *e.g.*: (1) Injuri of all types, but especially compound or punctured fracture (2) Middle-ear disease is perhaps the most frequent origin of thes affections, the infection reaching the brain through an opening i the tegmen tympani, or spreading from the mastoid process alon the sigmoid groove in which lies the lateral sinus. (3) It may extend inwards from scalp, face, or neck by way of the emissary veins, or even along the sheaths of nerves. (4) It may accompany simple contusion of the cranial bones (p. 747), as a result of an auto-infective inflammation in these structures.

The causative bacteria are generally of the usual pyogenic type— *i.e.*, staphylococci and streptococci; but the pneumococcus is not uncommon, and in the pus of cerebral abscesses the *B. pyocyaneus* and *B. coli* are occasionally found. In the so-called idiopathic form of diffuse meningitis the *Diplococcus intracellularis* of Weichselbaum is generally the causative organism.

It must be remembered that in actual practice the different forms of inflammation described below run into one another, and that the resulting symptoms are often a complex mixture of several types. For descriptive purposes the following groups may be differentiated:

(i.) **Subcranial Inflammation**, which manifests itself either as a simple thickening of the dura (*pachymeningitis*), or as an effusion of pus between the dura and the bone (*subcranial abscess*).

Simple Pachymeningitis results either from a slight simple depressed fracture, or from a contusion with or without a fissured fracture, or from the gradual spread of a mild infective inflammation from the overlying bone. The process is really protective in character, the dura becoming thickened. It may extend to the under surface of the dura, and lead to a localized lepto-meningitis, characterized by adhesions between the cortex and the dura. If the process extends no further, the clinical manifestations are slight, consisting merely of pain and localized headache. For treatment, see chron meningitis (p. 784).

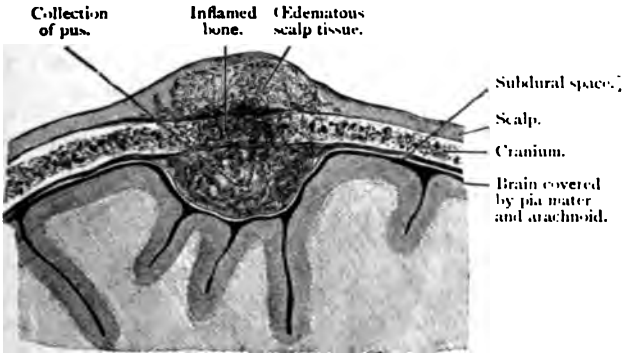
In some forms due to infection, the process continues and leads to an acute or subacute diffuse meningitis.

Subcranial (or **extradural**) **Abscess** results from either a compou depressed or a punctured fracture, in which the dura mater is only separated from the bone and not lacerated, especially when the external wound is small and efficient drainage is not obtained. It sometimes occurs, however, in consequence of a simple contusion or fracture of the skull, leading to a detachment of the membranes and

:tion primarily of blood and later of inflammatory fluids in the :hus produced. Microbic invasion is here due to auto-infec- to the passage of organisms through the bone. Any form)-myelitis of the cranial bones may determine its onset, but om injury, its most common cause is, without doubt, exten- inflammation from the middle ear.

:foration of the tegmen tympani allows of the invasion of the cavity, and an abscess forms above the attic, which, perhaps, ;es through the ear; in other cases the suppuration extends he groove for the lateral sinus. In the former instance a l subdural abscess may subsequently develop, limited by al adhesions, and the intervening dura mater may slough; utter thrombosis of the lateral sinus may follow.

Symptoms produced are (1) those generally characteristic of tion, viz., a high temperature, with perhaps rigors. (2) The



—Subcranial Suppuration, involving Overlying Bone and causing Œdematous Condition of the Scalp—Pott's Puffy Swelling (Semi-rammatic). (From Treves' 'System of Surgery.')

intracranial pressure in the form of fixed headache followed are also present. (3) If there is no open wound, an œdema- lling of the scalp, known as *Pott's puffy tumour*, may develop site of the abscess (Fig. 279). When there is a compound of the skull, the margins of the wound look unhealthy, and se may be seen bare bone, yellow and dry, from which the ium has separated, with perhaps pus oozing out between the ts. If the pus burrows towards the base of the skull, optic may develop. (4) Focal symptoms of spasm or paralysis plicate the case if the dura over the motor area is involved.

tment of such a condition consists in evacuating the abscess rough a sufficient opening made by trephining, or by remov- or diseased portions of bone, and providing for drainage. es more than one opening is required for this purpose.

the affection follows middle-ear mischief, the mastoid

although sometimes infection may be delayed beyond t
the early stages the patient complains of severe, con
creasing headache, associated with heat of head, a forc
of the carotids, a quick pulse, and general irritability
as indicated by vomiting, intolerance of light and so
and perhaps convulsive twitchings of the muscles, n
head and back, but also of the extremities. The vom
usual cerebral type, *i.e.*, it occurs apart from nausea, ar
tion to the ingestion of food. High fever is usually
possibly a rigor may occur at the onset. As the disea
the patient gradually becomes comatose, the pulse slov
respirations laboured, and death usually ensues in thre

According to the site of infection, the inflammator
may manifest themselves more acutely over one part tha
for descriptive purposes two chief varieties have been
viz., meningitis of the convexity and meningitis of th
general symptoms are alike in both forms, but when th
involved, convulsions are a more prominent feature in
may at first be limited to localized groups of muscles, v
meningitis the temperature tends to run higher, the h
are more retracted, optic neuritis is more frequent, and
squint is not uncommonly observed.

On *post-mortem* examination the skull-cap is separ
meninges with some difficulty ; the dura mater is thick a
and the subjacent veins are manifestly distended ; the
fluid is increased in amount, and turbid from admixtu
or pus ; the arachnoid is thick and opaque ; the surfa
volutions is flattened and œdematous, and lymph oc
sulci, matting them together ; the cortical gray matter
and congested ; the underlying white substance of the
is injected, numerous puncta cruenta being evident ;

room, and every source of irritation and excitement removed. Even if recovery ensues, it is somewhat delayed, and similar precautions as to quiet, etc., must be maintained for some time. In the later stages, blistering of the scalp or neck, and the administration of mercury, are advisable.

If the condition is due to a localized infective lesion, this must, of course, be dealt with by suitable means, *e.g.*, the middle ear must be opened up and diseased bone removed; depressed fractures must be operated on, and localized drainage effected, etc. Apart from this, attempts have been frequently made to relieve the symptoms and determine a cure by means of operative measures, directed towards reducing the intracranial tension; the subarachnoid space has been opened below the tentorium, whilst others have utilized Quincke's plan of puncturing the spinal membranes between the third and fourth lumbar vertebræ, *i.e.*, below the termination of the spinal cord (p. 764).

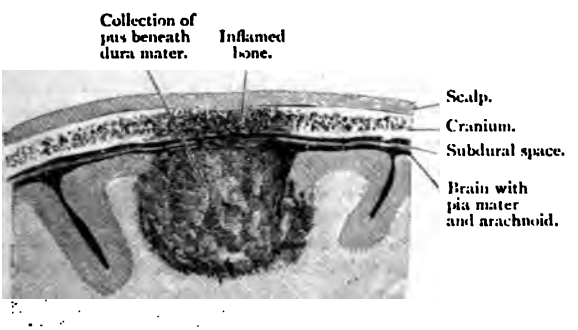


FIG. 280.—SUPERFICIAL ABSCESS OF BRAIN, SPREADING FROM SUBDURAL SPACE (SEMI-DIAGRAMMATIC). (FROM TREVES' 'SYSTEM OF SURGERY.')

In no case of acute meningitis has a successful result followed, and when one considers the intricate character of the space to be drained, the fact that it is sure to be subdivided into separate cavities by deposits of lymph, and especially when it is remembered that the brain substance is itself swollen, and that the important fourth ventricle only communicates with the subarachnoid space through the small foramen of Majendie, which is certain to be blocked early in the case—all these considerations go to prove that it is useless attempting any such measures.

Acute Meningo-encephalitis is sometimes *limited* in character. Such can only occur when there is no tension from retained discharges, diffusion along the meninges being prevented by the formation of adhesions. Localized subdural suppuration is usually present, involving even the brain substance; but with care recovery is possible, although an adherent cicatrix will be formed, perhaps giving rise to subsequent epileptic symptoms. It usually results from a localized inflammation of bone (Fig. 280), due to a contusion, a penetrating wound, or possibly to middle-ear mischief.

(iii.) A **Subacute** form of meningitis is occasionally met with, coming on at a somewhat later date. The patient may have apparently recovered from his injury, with the exception of a fixed pain in the head. The onset of the symptoms is often due to some indiscretion, and may be gradual or sudden. In all probability this affection is also microbic in origin, and the delay in its appearance depends either on the small number of bacteria present, or on their being in a low state of virulence; or possibly they have been latent for a time, and are aroused into activity by later causes; or, again, they may have gradually worked their way inwards along lymphatics or vessels from the periphery to the meninges. The symptoms are similar in character to those of acute meningitis, though somewhat less severe; but a fatal result is very apt to follow. In the *treatment* of this form, no active antiphlogistic measures should be adopted, since the patient's condition is somewhat asthenic. Absolute rest and quiet are essential; counter-irritation should be applied to the scalp and neck, and possibly mercury administered.

(iv.) **Chronic Lepto-meningitis** arises from very similar causes to the pachymeningitis already described (p. 780), but in addition may be associated with deep lesions, and may serve to limit the spread of infection; it is usually of a protective character. Syphilitic patients are perhaps more liable to its development than others. It is evidenced by infiltration and thickening of the membranes, which are usually adherent to one another and to the cerebral cortex. It gives rise to a localized headache, which is constant, and increased on excitement or the injudicious use of stimulants, whilst tenderness is often noted on deep pressure, and traumatic epilepsy may ensue. The *treatment* consists in attention to the general health, free action of the bowels, abstinence from excitement or stimulants, the local application of counter-irritants, and possibly the administration of mercury. For the question of operating for traumatic epilepsy, see p. 793.

(v.) **Tuberculous Meningitis** is a condition usually seen in children, due to an invasion of the meninges with tubercle. The pial vessels are chiefly affected, and the base of the brain is mainly involved. Inflammatory adhesions follow, and the free circulation of the cerebro-spinal fluid is checked by the blocking of the foramina of Majendie and Monro, so that the ventricles are often distended. For symptoms and clinical history, medical text-books must be consulted.

Many attempts have been made to deal with this affection by surgical means, especially by trephining through the occipital region and draining away the cerebro-spinal fluid, so as to relieve pressure on the fourth ventricle. One or two cases have recovered *post hoc*, but the prospects of success are indeed poor.

(vi.) **Infective Thrombosis of the Sinuses**, though occasionally seen after injuries, is more commonly associated with suppurative disease of the bone apart from trauma, and one variety, viz., that affecting the lateral sinus, is almost exclusively caused by disease of the middle ear. It is also induced by extension from scalp injuries or

complication of subaponeurotic cellulitis, or may spread inwards from erysipelatous or pyogenic lesions of the face, or suppurative conditions of the nose. Putting aside the results of chronic otorrhœa, the cavernous sinus is much more frequently involved than any other.

Pathologically, the same manifestations are observed as in any case of infective phlebitis. The sinus becomes impervious owing to the presence of a thrombus, and this in turn becomes disintegrated, and gives rise to multiple emboli, whilst various inflammatory conditions of the surrounding tissues necessarily result, *e.g.*, necrosis or caries of bones; subcranial abscess; meningitis, simple and localized, or septic and diffuse; or even cerebral or cerebellar abscess.

The *symptoms* are mainly of a pyæmic nature. The temperature is high, but with remissions, and often with repeated rigors; fixed headache and early and continuous vomiting are also marked features of the case. With these may be associated evidences of meningeal mischief, or of pulmonary trouble in the shape of dyspnœa, but sometimes diarrhœa and septicæmic manifestations may be the more prominent.

If the cavernous sinus is involved, marked exophthalmos, with congestion of the orbit, and even of the eyelids and face, may result, and ptosis or squint may also be set up by implication of the nerves which lie in the walls of the sinus.

If the superior longitudinal sinus is affected, there may be turgescence of the veins of the scalp and forehead, together with tenderness along the line of the sinus and epistaxis, whilst convulsions may be induced by irritation of the neighbouring motor area.

For local results and treatment of thrombosis of the lateral sinus, see p. 890.

Treatment, except for the lateral sinus, is but rarely possible, and hence the importance of preventing this disease by a most careful attention to asepsis. For the lateral sinus much can be done, but for the other sinuses all that is feasible is attention to general measures.

Abscess of the Brain.

Causes.—Pyogenic infection is, of course, the ultimate cause of all cerebral suppuration, but the manner in which the organisms find their way to the brain varies considerably.

(1.) It may be due to *traumatism*, either in the early or late stages of head injuries. In the *early*, it is usually superficial, and connected with some infective lesion of the scalp, cranium, or membranes, with or without a penetrating wound (Fig. 280). In the *later* stages the pus forms deeply in the white substance. It may be due to a penetrating wound, whether a foreign body is present or not, the microbes finding their way into the interior of the brain either through the track of the missile, or along bloodvessels or lymphatics. Sometimes it occurs apart from penetration, and then one can only suppose that it is due to auto-infection of a contused or lacerated area. Chronic abscess of this type is most frequently seen on the same

temporo-sphenoidal lobe is most frequently affected. tion may spread directly from the tympanic cavity or the mastoid process through the bone to the mem become adherent to the brain, and then into the cere Occasionally a subcranial abscess is first developed, a affection follows; sometimes a direct opening has beer the tegmen tympani into an abscess cavity, and it charged itself and been drained in this way. Mor layer of brain tissue intervenes between the membran and then infection will have been carried along vessels sheaths running from the meninges to the brain, or *vi*

Abscesses of a similar type occur in connection wi in the frontal sinus, the abscess being usually acute to a frontal osteo-myelitis, and occupying the anterio frontal lobe; it may also follow purulent infection of and ethmoidal sinuses, or thrombosis of the cavernou

(iii.) The infective material may be brought to th blood in pyæmia, or after some of the exanthemata, suc typhoid, etc. Abscess of the occipital lobe is alm pyæmic origin.

(iv.) A chronic abscess of tuberculous origin may a

A cerebral abscess is usually single; occasionally is present, *e.g.*, a cerebral and cerebellar may co-exist with middle-ear mischief. The course taken by the c chronic, and then the pus is encapsuled; in acute usually no limiting membrane. A chronic case no terminates in an outbreak of acute symptoms, due abscess bursting into one of the lateral ventricles, o vention of spreading œdema.

The **Symptoms** vary somewhat with the method of characters of the abscess. If traumatic and due to

When the symptoms are more characteristic, Sir W. Macewen describes them in three well-marked stages. (i.) In the *Initiatory Stage*, which lasts from twelve hours to two or three days, the patient is suddenly seized with severe pain in the region of the ear, radiating perhaps throughout the head, and accompanied by a rigor of some severity. The temperature and pulse are both raised, and vomiting of a cerebral type is present; the tongue is foul, whilst anorexia and constipation are well marked. During this period the otorrhœa diminishes or ceases entirely.

(ii.) In the *Fully-developed Stage* the patient lies quietly in bed in a dull, apathetic condition, able to answer questions but slowly, and with his brain evidently in a torpid state. The headache has to a great extent ceased, but tenderness over the temporo-mastoid region still remains. The temperature gradually falls and becomes sub-normal, and the pulse is slow and full. Respiration is usually slow, and in cerebellar abscess may be irregular. The vomiting and constipation continue, and the patient's mouth and breath become very offensive. The power of movement usually remains, but focal symptoms may manifest themselves, though in many cases of temporo-sphenoidal abscess they are not marked. If the cortex is mainly involved, the face is first affected, then the arm, and finally the leg; but if the abscess is deeper and presses on the motor fibres in the internal capsule, the order in which these parts are involved is reversed. Motor aphasia is sometimes well marked when the abscess is on the left side. If the abscess is placed posteriorly, it may press on the cerebellum through the tentorium, and cause symptoms of a cerebellar type. Optic neuritis is a somewhat unreliable sign, but if present is more marked on the affected side, whilst the corresponding pupil is dilated and fixed.

(iii.) The *Terminal Stage* is marked by a gradually increasing unconsciousness and death; or the abscess may burst into the lateral ventricle, causing sudden coma, a rapid rise of temperature and pulse, irregular respirations (often of a Cheyne-Stokes type), and death; or it may burst into the subarachnoid space, and then death is preceded by symptoms of diffuse lepto-meningitis.

The signs connected with a small **Cerebellar Abscess** are often very indefinite and vague, but if the abscess increases in size, the symptoms may become very characteristic. The patient complains of giddiness, and staggers when attempting to walk, falling towards the opposite side. The head and neck are retracted; respiration is irregular and feeble; the pulse is often slow and weak; paralysis may be noted on one or both sides of the body, and may only affect the upper extremity; of course, vomiting, optic neuritis, and a low temperature are present.

Diagnosis.—From *meningitis*, a cerebral abscess is usually recognised by the fact that in the former condition irritative phenomena, such as acute and active delirium, contraction of the pupil, photophobia, rigidity and spasm of muscles, especially in the back of the neck, and severe pain, are more evident and are produced earlier. The

temperature is usually high, and mental dulness comes on within three or four days of an injury, whereas an abscess rarely forms before the end of the first week. *Extradural abscess* (subcranial) is associated with a high temperature, earlier onset after an injury in traumatic cases, and more rapid compression symptoms; optic neuritis is unusual, and the vomiting is less troublesome. There is also likely to be some localized œdema or tenderness on deep pressure. In *thrombosis of the lateral sinus* the temperature is high and oscillating, optic neuritis may be absent, and there may be the characteristic tenderness in the neck; in abscess symptoms of compression are associated with a low temperature and marked optic neuritis. It must not be forgotten that the two conditions may co-exist. It is often impossible to diagnose between a chronic abscess and a *tumour of the brain*; the symptoms in the latter usually come on more slowly than in the former, but the progress is steady and unrelenting; the temperature remains near the normal, and there is less gastric disturbance. The history of the case may throw some light upon its nature, since in cases of cerebral abscess there is generally some causative septic focus. Tumour is more common in the frontal and parietal regions, abscess in the temporo-sphenoidal lobe. Optic neuritis is more marked and more common in tumour than in abscess.

Treatment necessarily follows the usual rule, viz., to give an exit to the pus as soon as possible; no delay is permissible when once the diagnosis is certain. The patient is prepared in the same way as for operation on a cerebral tumour (p. 792). A flap of scalp tissue is raised, and in such a manner as will most effectually serve for subsequent drainage purposes. The trephine is applied according to the rules given below, or in accordance with the special indications given by the symptoms of the case. Professor Macewen recommends that, when the circle of bone has been removed, the exposed surface and cut edge should be well rubbed over with powdered iodoform and boracic acid, so as to guard them from infection. The dura mater, which bulges into the wound and does not pulsate, is then carefully incised. A mere slit usually suffices, and this may open the abscess; but more usually the brain substance protrudes. It is carefully explored with a trocar and cannula, which is passed directly into it in various directions, or with a pair of sinus forceps. In a temporo-sphenoidal abscess the most likely direction to explore is downwards and inwards towards the tegmen tympani. Pus having been discovered, is allowed to escape by opening the blades of the sinus forceps. Sloughs are not uncommonly present in the cavity, and are removed by the gentle introduction of a curette, whilst it is wise to wash out the interior by gentle irrigation with sterilized salt solution. A drainage-tube is advisably inserted, and may be kept in position by stitching it to the margins of the incision in the dura, which is closed except for the passage of the tube. Sometimes it is wiser not to close the flaps around the tube, but to pack gauze round it, thereby determining the formation of adhesions, which will serve to shut off and guard from infection the meningeal cavity. The scalp flap is

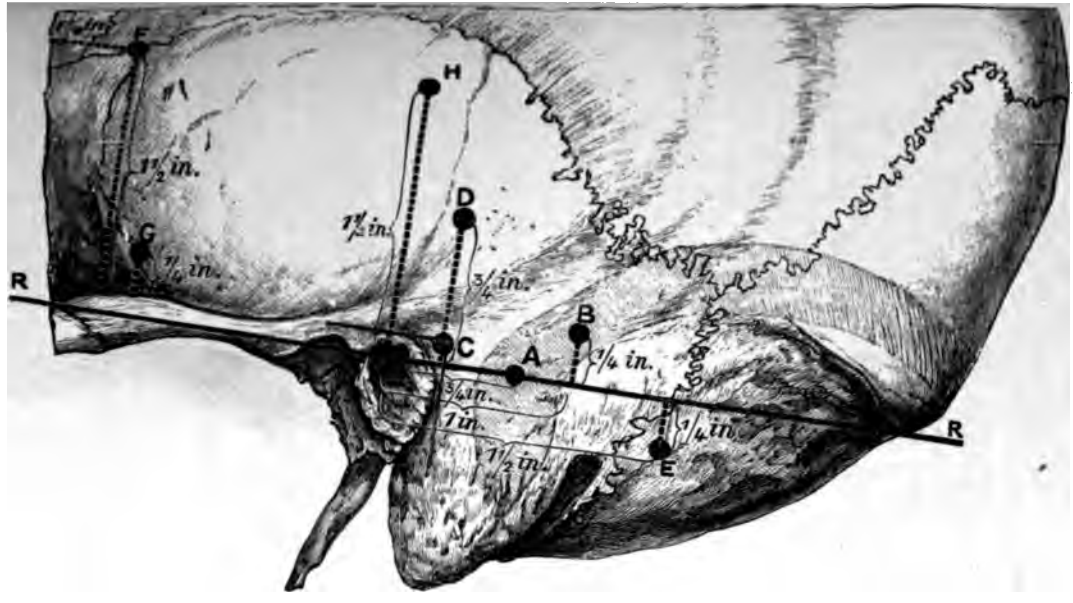


FIG. 281.—DIAGRAM OF ADULT SKULL (NATURAL SIZE) TO SHOW VARIOUS SPOTS FOR TREPHINING. (TREVES' 'SURGERY.')

The horizontal measurements are taken along Reid's base-line, R, R, which passes through the centre of the external auditory meatus the vertical measurements are taken by drawing lines at right angles to the base-line. A, The sigmoid portion of the lateral sinus, a point ¾ inch along the base-line from the centre of the meatus; B, the transverse portion of the sinus, 1 inch behind the meatus, and ¼ inch above the base-line; C, the mastoid antrum, the point of meeting of two lines—one drawn along the upper wall of the meatus and parallel to the base-line, the other along the posterior wall of the meatus at right angles to Reid's line; D, for temporo-sphenoidal abscess, a line drawn ¾ inch upwards through the posterior border of the meatus at right angles to the base-line; E, for cerebellar abscess, 1½ inches behind the centre of the meatus, and ¼ inch below the base-line; F, for anterior branch of middle meningeal, 1½ inches behind external angular process of frontal bone, and 1½ inches above the zygoma; G, for posterior branch of middle meningeal, 1¾ inches behind external angular process, and ¼ inch above zygoma; H, for tapping lateral ventricle 1½ inches above centre of external auditory meatus.

replaced in position, the tube being brought out through its centre, if need be. The tube is retained in position for two or three days, and is then removed. Symptoms of re-accumulation or of extension of the mischief to the meninges will, of course, necessitate a re-opening of the wound, and the institution of free and effective drainage. Occasionally a hernia cerebri develops as the result of opening a cerebral abscess.

For an abscess in the temporo-sphenoidal lobe, the centre-pin of the trephine may be placed 1¼ inches above Reid's base-line, and directly above the external auditory meatus; but a better situation is a spot ¾ inch above the posterior root of the zygoma, and directly above the posterior border of the osseous meatus (Macewen; Fig. 281, D). For an abscess in the cerebellum the point selected is 1½ inches behind the centre of the external auditory meatus, and ¼ inch below the base-line (Fig. 281, E). In the latter case the soft parts, including the muscles and periosteum, should be stripped off the occipital bone, and turned downwards, and it is usually inadvisable to apply a trephine, as the bone is very thin, and may be broken through with a gouge. It is often necessary to carry through the cerebellar operation rapidly, as the respirations sometimes stop under an anæsthetic, though the heart continues to beat forcibly; as soon as the dura is opened, the respirations recommence.

In middle-ear disease the diagnosis, both as to the presence of an abscess and its situation, is often doubtful. The antrum and attic are then opened and explored thoroughly, and according to whether the disease is more marked in the former or latter, the further steps of the operation are directed towards the cerebellum or cerebrum. By carefully removing bone behind and above the antrum, the lateral sinus is exposed; and by working above or below it, the cerebrum or cerebellum can be examined, and, if need be, incised. A similar result can be obtained by applying a ¾-inch trephine to a spot 1 inch behind the meatus and ½ inch above the base-line (H. P. Dean). The lateral sinus lies in the lower portion of the opening, and the dura over the temporo-sphenoidal lobe in the upper; by enlarging the opening downwards by Hoffman's rongeur, the cerebellum can also be explored.

Cerebral Tumours.

The chief Varieties of new growth met with in the brain are as follows: (i.) *Glioma*, which consists of a small round-celled neoplasm with a very delicate intercellular substance, similar in character to the neuroglia (p. 197); it may occur in any part of the brain. It is always continuous with the surrounding cerebral tissue, and is scarcely ever encapsuled, so that to the naked eye it may be indistinguishable from brain substance, although rather harder, and hence its limits can seldom be accurately defined. (ii.) *Sarcomata* also occur, and occasionally psammomata (p. 215) and secondary carcinomatous deposits. (iii.) *Tuberculous foci* are met with either associated with or apart from any meningeal infiltration, varying in size from

siderably, and may be either firm and caseous, or with a diffluent centre. (iv.) *Gummata* of the brain usually spring from the meninges, and are more irregular in shape than tuberculous masses. (v.) Occasionally *hydatid cysts* are found, as also other less common conditions.

Cerebral tumours are more often observed in males than in females, and the different forms occur at varying periods of life. Thus, glioma and sarcoma are most common at puberty or in middle life; tuberculous foci, in children; gummata, in the fourth or fifth decade; carcinomata, in middle or late life; and parasitic tumours in the second and third decades.

The *local effects* of a cerebral tumour may be to cause some amount of sclerosis of the surrounding brain substance, whilst, if superficial, the membranes may become adherent and the overlying bone thickened.

The **Symptoms** of a cerebral tumour can be classified as follows: (1) Those due to increased intracranial pressure, such as fixed headache, giddiness, epilepsy, loss of memory, and stupor, finally ending in coma. The headache varies much in character, but is usually localized, occurs in severe paroxysmal attacks, and is often associated with tenderness on deep pressure over the scalp. It is increased by anything that causes passive congestion of the brain, such as coughing, and it is most important to note that the sites of the maximum pain and of the tumour often correspond. Occasionally coma and a fatal issue supervene suddenly as a result of acute spreading œdema (p. 771). (2) Vomiting and constipation are also very marked phenomena, associated with loss of appetite, foul breath, and great emaciation. The vomiting bears no relation to the ingestion of food, and is not preceded by nausea. It often develops concurrently with the pain, or may relieve it, and is most common in subtentorial tumours. The temperature is usually subnormal, but if there is any basal meningitis it may be elevated. (3) Optic neuritis is generally present, and is supposed to be due either to the increased intracranial pressure, causing obstruction to the return of blood from the eye to the cavernous sinus, or to a descending neuritis, or possibly to both. In the early stages, the clear definition of the disc margin becomes obscured, and the retinal veins congested and tortuous; the retina is œdematous, so that the vessels are only seen at intervals, and linear ecchymoses may also occur. If the patient lives long enough, atrophy of the disc follows. In the early stages vision may be but little affected, but, as a rule, it is considerably impaired towards the end. In some cases this condition may be more marked on the side of the lesion, but is generally bilateral. (4) Focal symptoms are of great value for localizing the lesion. Irritative phenomena are first produced, and subsequently paralysis. If the cortex of the motor area is involved, Jacksonian epilepsy often results, with an aura corresponding to the centre mainly affected; the convulsions spread in a regular order, and may involve the opposite side of the body and even produce unconsciousness. At a later date localized paralysis may occur. When the subcortical white

substance is the focal point, paralysis ensues early, apart from spasmodic phenomena. Affections of the functions of sensation, vision, speech, hearing, etc., are produced when other parts of the brain are involved; but we must refer students to text-books of medicine for a further consideration of these lesions. The surgeon is seldom called upon to make a diagnosis in these cases, and therefore the full details of this intricate subject will not be considered here.

Treatment.—In every case, the possibility of the symptoms being due to gummatous disease must not be forgotten, and large and increasing doses of iodide of potassium (even up to 40 or 60 grains three or four times a day) should be administered before undertaking operative proceedings. Symptoms of gastric irritation must be prevented by giving some alkaline carbonate (especially the ammonium or soda salts), whilst the dose should be freely diluted with water.

Operation.—It is most desirable that this should be undertaken as early as possible, since, even if no tumour exists, the patient runs but little serious risk, whilst delay until all the classical symptoms are well marked may prevent the total removal of the growth.

The scalp should be entirely shaved a day or two previously, and very thoroughly purified. A quarter of a grain of morphia is injected about half an hour before the operation, with the idea both of reducing the vascularity of the brain and of dulling the patient's sensations, so that a smaller amount of anæsthetic is subsequently needed. Chloroform should be employed rather than ether, as it produces less congestion of the head. The surgeon marks the supposed site of the growth on the skull with a bradawl through the scalp. A large semicircular flap is then turned down, exposing a considerable area of the calvarium, so that if a larger amount of bone than is expected needs to be removed, no fresh scalp incisions are required; moreover, the cicatrix will in this way be prevented from forming over the opening. One of the methods of opening the cranium already described (p. 763) is then employed; the further proceedings on the brain are carried out at once, or the intracranial portion of the procedure is delayed for a week or so. Under such circumstances the wound is re-opened, and the dura mater exposed.

The dura mater when laid bare under normal conditions is firm, but yields slightly to the finger, and allows the pulsation of the subjacent brain to be felt, if the latter is healthy and no undue pressure is present within; but if the intracranial tension is markedly increased, the dura mater bulges into the wound, feels firm and unresisting, and the cerebral pulsations are diminished or absent.

The dura mater is next incised crucially, or a flap turned down, care being taken to avoid, if possible, the meningeal vessels; the brain substance protrudes if the intracranial pressure is excessive. The region is gently explored by the finger, and any areas of abnormal hardness or softening noticed; failing this, a grooved needle is inserted in different directions, or a fine trocar and cannula. In introducing such instruments, care must be taken to make direct stabs, and never any lateral movements, which necessarily lead to

laceration of the brain. The opening of the skull may be enlarged, if need be, either by the use of the bone rongeur or by additional small trephine holes. It is but rarely that a cerebral tumour is so placed that enucleation is possible; it is estimated that not more than 10 per cent. of all cerebral tumours are removeable. If, however, a cortical neoplasm is found, it is isolated from the surrounding brain substance by blunt instruments, *e.g.*, the handle of a scalpel, or a flexible knife, made of platinum, as suggested by Horsley, and the mass freely removed. Hæmorrhage is controlled by the application of fine ligatures, or by the use of serrefines, or by sponge pressure. The dura mater is then loosely stitched together, and a drainage-tube inserted, reaching to the bottom of the wound, and brought out at one angle of the incision in the skin, which may be closed by a continuous suture. If a small tumour, and presumably non-malignant, has been satisfactorily enucleated, the disc of bone may be replaced, room, however, being left for the passage of the tube; but if there is any doubt as to its complete removal, the opening in the bone is left. After the operation, the patient must be kept absolutely quiet, with the head slightly raised. The drainage-tube is removed in twenty-four or forty-eight hours, and the scalp wound is usually healed in six or seven days.

Even if the tumour is inaccessible or irremoveable, temporary benefit often results from an exploratory operation, since a subcutaneous hernia cerebri is thereby allowed to form, and intracranial tension relieved, as evidenced by an improved mental condition and loss of pain; as the tumour grows, however, the patient relapses into his former state, and death follows sooner or later.

The Surgical Treatment of Epilepsy.

It would be waste of time to discuss the many surgical procedures which have been suggested in this connection, *e.g.*, ligature of the carotid or vertebral arteries, total excision of the cervical sympathetic chain on each side, etc., mainly devised with the idea of modifying the cerebral circulation. The only operation now seriously considered is that dealing directly with the cerebral cortex, a proceeding dependent on the supposition that the epileptic convulsion is a symptom, and not in itself a disease, and that it results from an irritable condition of the cortex, which may be excited into convulsive activity by various stimuli, originating either in the brain or elsewhere. Sir Victor Horsley* classifies epilepsy as follows:

(1) Idiopathic (with no gross lesion).
  (*a*) Onset localized (focal).
  (*b*) Onset generalized.
(2) Jacksonian (always some gross lesion or traumatism).
  (*a*) Traumatic (with local or general convulsion).
  (*b*) Congenital.
  (*c*) Neoplastic (tumour, abscess, aneurism).

* *Trans. Medical Society of London*, February 9, 1903.

(3) Reflex (injury of spine, nerves, etc.).
(4) Hystero-epilepsy.

As regards the characteristic symptoms and pathological phenomena found in many of these conditions, students must refer to medical text-books.

Before discussing the individual groups from the surgical standpoint, one or two general considerations must be noted. In the first place, the prognosis is gravely modified by the length of time that the epileptic habit has persisted, and in traumatic cases if the affection has lasted two years the outlook is very unsatisfactory. A careful study should also be made of the family history as to the existence or not of a neurotic predisposition; in many cases of traumatic epilepsy this is well marked, and then the outlook is correspondingly bad.

It is now generally recognised that operation is useless in the idiopathic variety, even when the onset is accompanied by focal symptoms.

Congenital epilepsy is often more or less of the Jacksonian type, and usually depends on some injury sustained during birth. It is frequently associated with other evidences of cerebral mischief (spasm, paralysis, etc.) and with defective growth. If taken early, and if the convulsions still remain localized, some good may follow operation; but if allowed to progress too far, the disease is irremediable by surgical means.

When due to *tumours*, *abscess*, etc., epilepsy is accompanied by other manifestations, which should guide the surgeon to a correct opinion as to the nature of the case and the operative outlook.

Reflex epilepsy is rare, and may perhaps be cured by dealing with the causation focus. As regards **hystero-epilepsy**, the surgeon must never be tempted to undertake such a measure as double oöphorectomy, which has been again and again tried and found wanting.

Traumatic Epilepsy is the term applied to an epileptic condition resulting from injuries. It may arise from any of the following conditions: (1) A neuralgic and irritable cicatrix in the scalp; (2) a slight unrelieved depression of the skull; (3) excessive formation of callus after a fissured fracture, or chronic thickening of the bones from osteitis after a contusion, whereby the dura mater is pressed upon and irritated; (4) chronic meningitis, usually associated with an adherent cicatrix in the brain, and particularly liable to occur in syphilitic patients; (5) a single depressed spicule of bone projecting into the cerebral substance.

The **Symptoms** produced are epileptic seizures of the Jacksonian type, the exact manifestations varying with the portion of cerebral cortex which is involved. Localization of the lesion depends partly on the character of the aura, partly on the associated symptoms, such as a fixed headache or the presence of a cicatrix. The convulsions are localized to begin with, but often become general.

Operative Treatment is only applicable in those cases in which the convulsions remain localized; general convulsions place the patient

in the category of idiopathic epileptics with a focal onset. The skull is opened over the site of the supposed injury, and it may be that some depressed fragment or spicule of bone may be found; it will, of course, be removed. If, however, nothing is found but an adherent cicatrix between the membranes and the underlying brain, it is still an open question as to whether the surgeon should proceed further. In a considerable number of cases the cicatrix and underlying brain substance have been removed; the fits ceased for a time, but in most instances recurrence followed sooner or later from the formation of a fresh adherent cicatrix. At the present time the surgeon should introduce a sheet of sterilized gold or silver foil between the brain substance and the membranes to prevent this occurrence. The locality of the lesion has a considerable influence, according to Horsley, on the result, since the prognosis is good in the motor area, middling in the sensory (parieto-occipital) region, and bad in the frontal. The obvious difficulty of dealing with epileptic conditions emphasizes the statements already made (p. 756) as to the importance of dealing with all depressed fractures of the skull, simple or compound, slight or severe, by immediate operation, so as to prevent, as far as possible, the development of the mischief.

Traumatic Insanity is sometimes produced by slight depressions or lesions, similar in nature to those causing epilepsy, and can occasionally be relieved by operation. Certainly, when a distinct history of injury precedes the mental aberration, and when there is any localizing lesion or symptom, an exploratory operation is justifiable, and in a number of cases excellent results have followed. The type of insanity is not constant, but varies with the condition and environment of the individual.

Hernia Cerebri.

By hernia cerebri is meant a protrusion of the brain substance through an *acquired* opening in the skull. It thus differs from an encephalocele, which consists in the protrusion of brain substance through some *congenital* defect.

It is always an evidence of increased intracranial pressure, and may be looked upon as Nature's safety-valve for the relief of compression. It is met with in two distinct forms:

1. When an opening has been made by the surgeon for the treatment of a cerebral tumour, which is subsequently found to be irremoveable. The disc of bone is not replaced, and the brain substance protrudes through the opening under the scalp; by this means a temporary relief of intracranial tension is brought about, the patient's life prolonged, and possibly consciousness for a time restored. The tumour, however, continues growing, and sooner or later the patient dies comatose.

2. The other variety, due to a compound depressed or punctured fracture, is the result of sepsis in the underlying brain substance, and the increased pressure within the skull thereby induced leads to a

protrusion of inflamed and œdematous brain matter thro
wound in the dura, which is usually of small size. The tu
soft and dusky in colour, and pulsates synchronously with th
the pulsations being often evident to the naked eye, and it
increases in size somewhat rapidly. At first the mental con
the patient is unimpaired, but sooner or later coma follows
hernia progresses, ending in the patient's death. To begin w
mass consists mainly of œdematous granulation tissue cov
blood-clot, without much brain substance, but later on brai
itself may protrude. The condition is usually fatal, though r
is occasionally seen. **Treatment.**—Prevention of this affecti
always be aimed at by endeavouring to render any wound in
the meninges aseptic and providing for drainage. Punctured
and depressed fractures of the skull, even when giving ris
urgent symptoms, should always be operated upon, since fr
of tension may prevent the formation of a hernia cerebri, even
absolute asepsis not be attained. If, however, protrusion oc
may be possible in a few cases to apply a dry dressing and
pressure, and thus prevent it increasing in size; this, howeve
not be attempted when the inflammatory symptoms are
marked. In such cases it is of little use to slice off the tum
apply pressure, and possibly the best treatment that ha
suggested is to paint the projecting mass with absolute alcoh
or twice a day; it is an efficient antiseptic, and also tends
dehydrating power to diminish the size of the hernia. If suc
ment is successful, the tumour slowly granulates over and cic
Traumatic epilepsy may, however, ensue.

CHAPTER XXVII.

AFFECTIONS OF THE LIPS AND JAWS.

Affections of the Lips.

Hare-lip.—By hare-lip is meant a congenital fissure of the upper lip, which may extend for a variable distance through the soft tissues alone, or may also implicate the bony alveolus and the floor of the

FIG. 282.—SINGLE INCOMPLETE HARE-LIP, INVOLVING MERELY THE TISSUES OF THE LIP, AND NOT EXTENDING INTO THE NOSE.

FIG. 283. DOUBLE HARE-LIP: COMPLETE ON THE LEFT SIDE, INCOMPLETE ON THE RIGHT.

A B

FIG. 284.—DOUBLE COMPLETE HARE-LIP, WITH DISPLACEMENT FORWARDS OF THE CENTRAL PORTION OF THE INTERMAXILLA (OS INCISIVUM).

A, Front view; B, seen in profile.

nose, and extend backwards through the palate. The name is not a good one, since a hare's lip is cleft in a Y-shaped manner, the fissure being central below, and bifurcating above into each nostril.

Varieties.—A hare-lip is *complete* or *incomplete*, according to whet or not it extends into the nostril. It is termed *simple* if limited the soft parts; *alveolar*, if the bony alveolus is also involved; *complica* if associated with a cleft palate. The defect may exist on one both sides of the middle line; if *unilateral* or single, it is most comm on the left side, in the proportion of two to one; if double or *bilate* it is usually, but not invariably, alveolar, and accompanied a complete cleft of the palate. The central portions of the lip a alveolus (os incisivum) may either retain their normal position, as is more frequently the case in the bilateral type, project forwa at the end of the nose, forming a proboscis-like appendage (Fig. 2 A and B). Even in simple cases the nose is deformed, being br

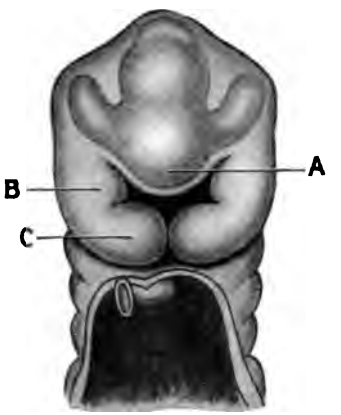


FIG. 285.—HEAD OF FŒTUS OF ABOUT FIVE WEEKS, FROM VENTRAL ASPECT (AFTER HIS), SHOWING THE PRIMITIVE STOMODÆUM BOUNDED ABOVE BY (A) THE UNDIVIDED FRONTO-NASAL PROCESS, LATERALLY BY (B) THE MAXILLARY, AND BELOW BY (C) THE STILL SEPARATE MANDIBULAR PROCESSES.

The quinque-radiate appearance is well represented.

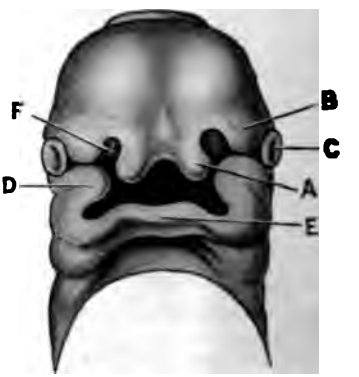


FIG. 286.—HEAD OF FŒTUS OF SIX SEVEN WEEKS, FROM THE VENTR ASPECT. (AFTER HIS.)

The mandibular processes (E) have n united; the ocular vesicle (C) is s on either side towards the upper e of the orbito-nasal fissure, and t fronto-nasal process has develop (A) internal and (B) external nas processes on either side of (F) the s unclosed anterior nares.

and flattened, a condition which becomes much more marked whe the alveolus and floor of the nose are widely fissured. Hare-lip i not uncommonly associated with other deformities—*e.g.*, spina bifid and talipes—and it is frequently transmitted from one generation t another. Occasionally a thin red line, as of a cicatrix, is seen occupying the position of a hare-lip cleft, and is probably due t a persistence of the raphe of union of the labial segments; a slight groove in the alveolus may also be observed at a correspondin point.

Development.—(For fuller details of the development of hare-lip and cleft palate, we must refer readers to 'Hare-lip and Cleft Palate,' by W. Rose; Lewis and Co., 1891. Space only permits a very brief summary here.) The bony and fleshy parts of the face originate from the outgrowth of processes around the cavity formed by the bending forward of the primitive cerebral vesicle over the end of the notochord. At about five weeks after conception the primitive buccal cavity or stomodæum has a quinque-radiate appearance, due to the manner in which these processes are formed (Fig. 285). A broad median lappet (fronto-nasal process) descends from above; this is separated by a fissure on each side from the symmetrically-placed maxillary processes, and these again below from the more prominent mandibular processes, which early unite across the middle line, to form the lower jaw. The fronto-nasal process soon, however, changes developing four rounded buds, the relations of which are indicated in Fig. 286. On either side of a slight depression in the median line is placed the internal nasal process (A), from which are produced superficially the central portion of the upper lip, and from its deeper aspect the inner segment of the intermaxilla (endognathion, Fig. 287, EG), carrying the central incisor. Separated from this by a hollow (F), which subsequently forms the anterior nares, is the rounded external nasal process (B), from which develop the side of the cheek, the ala nasi, and from its deep side the outer segment of the intermaxilla (mesognathion, MG) and probably the lateral incisor. External to this a fissure runs up to, and even beyond, the primitive eye (naso-orbital fissure), and this is later on closed by amalgamation of the internal and external nasal processes on the inner side with the adjacent maxillary process on the outer (D), except in the deepest part, which constitutes the nasal duct. The integrity of the upper lip is obtained by the union of the lower parts of the internal nasal and maxillary processes, which thus exclude the external nasal from participation in its free border. It is doubtless owing to this arrangement that the sulcus or depression around the ala nasi constitutes such a distinct and characteristic feature of the face. At the same time the deeper parts of these nasal processes are uniting with one another and with the palatal plates, which grow horizontally inwards from the under side of the maxillary processes, uniting in a Y-shaped suture, the point of junction of the limbs being situated at the anterior palatine canal. The union of all these elements is taking place from the sixth to the tenth week, and by that date even the uvula, the last part to unite, should be complete.

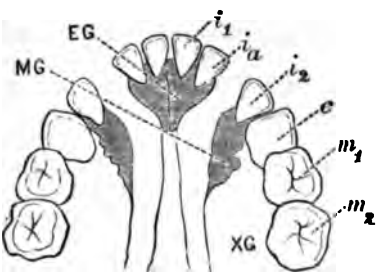


FIG. 287.—DIAGRAM TO REPRESENT THE ALBRECHT THEORY OF HARE-LIP, SHOWING THE SITUATION OF THE CLEFT IN THE ALVEOLUS BETWEEN THE INNER AND OUTER SEGMENTS OF THE INTERMAXILLA.

EG, Endognathion; MG, mesognathion; XG, exognathion; i_1, central incisor; i_2, lateral incisor; c, canine; m_1, m_2, first and second molars.

Ordinary hare-lip is due to a failure of union of the internal nasal process with the structures in external relation with it; if limited to the soft parts (simple hare lip), the cleft runs between the internal nasal and maxillary processes; if complete or alveolar, between the same two below and superficially, but in addition between the internal and external nasal processes above and on the deep side. The cleft in the alveolus passes between the inner and outer segments of the intermaxilla (Fig. 287), and is thus bounded on the inner side by the central incisor, on the outer side by the lateral incisor. Occasionally two teeth are found growing from the endognathion, the outer of the two being an accessory tooth, whilst the lateral incisor, and presumably the outer segment of the intermaxilla, are often undeveloped, or exist in a very rudimentary condition attached to the maxilla.

also be remembered that all movements of the face or laughing—exaggerate the deformity from the unba of the divided orbicularis oris and other muscles.

As to the *period* at which to operate, it is better to all to get over the shock of its entrance into the world acclimatized to an independent existence, whilst at th the operation should be performed before the trouble begin. From six weeks to three months is perhaps the operation—in well-nourished and healthy children at th in poorly-fed and weakly children at the later, unless is due to the difficulty of giving nutrition owing to th Under such circumstances the operation may have to b within the first three weeks.

Operation for Single Hare-lip.—The child should b operating-table with its arms bound to the body. stands behind it, the anæsthetist and assistant one The operation may be described in three stages:

1. The *lip* is thoroughly *dissected up from the maxillæ* a cutting through the reflections of mucous membrane an ment of the muscles and other soft parts. This is mair the outer side, and where there is much flattening of ala nasi will also require to be separated. This may amount of bleeding, but sponge pressure easily controls

2. The *edges of the cleft* are then *pared*. Many diffe have been employed to accomplish this, but it is only mention two. The object to be attained is the union o by means of a cicatrix, which shall be as unobtrusive whilst the red margin must be continuous, and the sect the raw surfaces are larger than are absolutely neces allow for subsequent cicatricial contraction without the of a notch. The methods recommended are as follows:

the cleft are pared, so as to leave a raw surface ; a flap of red marginal tissue, as thick as possible, is then cut from the outer side, and implanted on the bevelled raw surface of the red margin on the inner side, the upper portions of the cleft being also apposed.

3. *Sutures* are now inserted to maintain the lip in the position into

FIG. 288.—ROSE'S OPERATION FOR SINGLE HARE-LIP.

On the left side the semilunar incisions are seen extending as far as the free borders of the lip. The right-hand figure shows the parts drawn into position; the wide cross lines represent the wire sutures, the narrow ones the catgut or horsehair stitches.

which it can be drawn by the fingers without tension. Two deep silver-wire sutures should be introduced, one just above the red margin, and one close to the nose, to draw into position and steady the nostril, which should be left smaller than that on the other side, so as to allow for subsequent dilatation, which is certain to occur.

FIG. 289.—MIRAULT'S OPERATION FOR HARE-LIP.

In the right-hand figure the prolabial flap is shown ready to be implanted on the prepared inner side.

Horsehair or catgut stitches are used to bring the exact margins together, the continuity of the muco-cutaneous line being accurately preserved, and the cut edges of the mucous membrane upon the deeper aspect being sutured, each stitch, after it is tightened, being used to elevate and evert the lip and thus assist the insertion of the

on the flexor side of each arm to control the elbow-joint

The **Treatment of Double Hair-Lip** may be discusse headings, viz., the treatment of the os incisivum, and th parts.

The os incisivum need not be touched if it retain

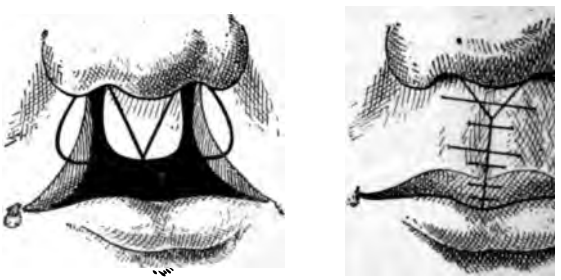


FIG. 290.—ROSE'S OPERATION FOR DOUBLE HARE-L

The central tubercle is pared in a V-shaped manner, and the late curved incisions, extending to the red margin, and then inw apex of the central portion is included in the completed lip. lines represent the position of the wire stitches, the shorter or sutures.

position, and the labial clefts are then alone dealt w projects forwards, as is often the case, it must be eithe replaced. (*a*) In the former case the central portion of is freed from it by dissection, and the base of the process cutting-pliers; a small artery in the bone will spurt vi may need an application of the cautery to stop it. The the lip is deferred till ten days later. (*b*) Reposition m by several methods, the best of which is Bardeleben's

wards from rotation of the process, and that its presence prevents the maxillæ from falling together and increases the difficulties of subsequently closing the palatal cleft. Personally we recommend extirpation in bad cases, since the disfigurement can to a large measure be removed by adding a projecting cheek-plate to that which carries the artificial incisors, thus pushing the upper lip forwards. (*c*) Where, however, the projection is not great, it is possible to diminish the size of the os incisivum by gouging away the teeth contained within it, so that the lip can be closed over it.

The soft parts of the lip are dealt with in much the same way as in single hare-lip. They are freely detached from the maxillæ, and the edges pared, as shown in Fig. 290, the central portion being cut into a V, and no attempt made to incorporate it into the free margin for fear of depressing the tip of the nose, whilst the lateral segments are pared as in the single operation. These latter are now drawn together and united in the middle line below the central portion, so that a Y-shaped cicatrix results. One of the deep silver stitches should fix the apex of the V; the other should be inserted just above the red margin. The dressing and after-treatment are as in the single operation. For a time the child may have difficulty in breathing owing to the diminution in the size of the oral aperture, but this is obviated by the nurse drawing down the lower lip with the fingers, or by painting it in a vertical direction with collodion.

FIG. 291. MEDIAN HARE LIP. (PITTS' CASE.)

Other congenital abnormalities of the lip are met with, which, however, can only be briefly mentioned here.

Median Hare-lip may occur in one of two forms: either a simple cleft exists in the middle line (Fig. 291), or there may be an absence of the intermaxilla and nasal septum, causing flattening of the bridge of the nose, and a broad median defect, flanked by the maxillary portions of the lip.

Oblique Facial Cleft is an uncommon deformity, characterized by a cleft or sulcus in the face, starting from the usual situation of a hare-lip below, but running up outside the nostril to the inner side of the lower lid (Fig. 292). Coloboma of the iris or choroid is sometimes associated with this rare defect. The deformity is due to non-closure of the naso-orbital fissure, and runs along the line of the nasal duct. It may be limited to the soft parts, or may involve the bones, even laying open the antrum.

Macrostoma (Fig. 293) is characterized by an abnormal width of the mouth, and is due to non-union of the maxillary and mandibular processes. It may be uni- or bi-lateral, and is usually associated with anomalies of development of the ear, accessory auricles being often present. As a rule, a small papilla on the upper and lower margins will indicate the true limits of the mouth, being constituted by the points of attachment of the orbicularis. The existence of these is of great importance as indicating the extent to which the cleft must be pared in order to restore the mouth to its normal size.

Mandibular Clefts are exceedingly rare. They are due to non-union of the mandibular processes in the middle line, and involve either the soft tissues of the

lower lip alone, or may extend to the bone, and even the tongue. Treatment is as for ordinary hare-lip.

Microstoma is the term applied to a condition in which the fusion of the parts entering into the formation of the lips progresses to a greater extent than usual, so that the oral orifice is contracted. It may be associated with defective development of the lower jaw. In the more severe cases, where the mouth is extremely narrowed, a transverse cut should be made outwards on each side, and the mucous membrane stitched to the skin.

Macrocheilia, or hypertrophy of the lip, occurs in three forms: 1. The congenital variety, a condition analogous to macroglossia, and due to a congenital distension of the lymphatic spaces, or chronic lymphangiectasis, accompanied by overgrowth of the connective tissue. The lower lip is most often involved, and is firm, thickened,

FIG. 292.—OBLIQUE FACIAL CLEFT, OR, RATHER, CICATRICIAL DEFORMITY ALONG THE LINE USUALLY TRAVERSED BY SUCH A CLEFT. (KRASKE'S CASE.)

FIG. 293.—MACROSTOMA WITH AURICULAR APPENDAGES. (FERGUSSON.)

and everted, causing considerable deformity. The treatment consists in the removal of a V-shaped portion from the centre. 2. An acquired form occurs in children and young people with a tuberculous inheritance, constituting the so-called 'strumous lip.' Either lip may be affected, but perhaps more frequently the upper; the thickening is due to a chronic lymphangitis, resulting from the absorption of septic material from persistent cracks and fissures. If these can be healed, and the general health improved, diminution in the size of the lip soon follows. 3. In adults, macrocheilia is in almost all cases due to tertiary syphilis. The lower lip is most often enlarged, and becomes thick and hard. It is due to the diffuse sclerosis characteristic of tertiary mischief. General treatment, and not local, is needed.

Syphilitic Affections of the lip are not uncommon. A *primary*

chancre may be caused by kissing, or by smoking an infected pipe, or drinking from a glass with an infected rim. It usually presents a smooth ulcerated surface, discharging a small amount of sero-pus, resting on a mass of infiltrated tissue which may extend over the whole lip (Fig. 294). The induration is not so great as in chancres upon the genital organs, but the infiltration is much more extensive. An indolent enlargement of one or more of the submaxillary lymphatic glands occurs very early, and the disease usually runs an acute course. Ordinary specific treatment is all that is needed. A labial chancre may closely resemble epithelioma, but is distinguished from it by its rapid development up to a certain point, by the early implication of the glands, which soon become very large, by the absence of typical cachexia, by the age of the patient, and the course taken by the case, as well as by the local appearances. The surface is usually flattened, and less warty and irregular than in epithelioma, whilst the skin is more involved than the mucous membrane. Should the chancre have existed for any time, the presence of a rash or sore throat may materially assist in forming a diagnosis. Moreover, it is said to be more common on the upper lip, whilst epithelioma is usually seen on the lower (compare Figs. 294, 295). In the *secondary* stage mucous tubercles are frequently met with, involving the inner side of the lip and the angle of the mouth. In the *tertiary* period serpiginous ulceration and gummata may occur, or the diffuse induration described above. In *inherited* syphilis, cracks and mucous tubercles are constantly present, and may be so extensive as to leave cicatrices radiating from the mouth, which are very characteristic (Fig. 21).

FIG. 294.- CHANCRE OF UPPER LIP. (FROM A PHOTOGRAPH.)

The enlargement of the submaxillary lymphatic glands is very evident.

Cracked Lips (or, as they are often called, *chapped lips*) are usually the result of cold weather, a central crack or fissure forming which is extremely painful, and liable to bleed very readily on everting or stretching the part. The lower lip is that generally affected. In tuberculous children more than one may occur, and by their persistence they give rise to a considerable degree of induration and infiltration, and perhaps lead to glandular trouble. All that is needed in the shape of *treatment* is the application of a little lanoline or cold cream, but if they persist, it may be advisable to touch them with nitrate of silver.

Herpes Labialis is a condition usually associated with catarrh, an not unfrequently with pneumonia or other fevers. Either lip may b affected, and the herpetic eruption is quite limited in extent. I consists of a number of little vesicles situated on a hyperæmic an painful base; after a few days the vesicles become transformed int pustules, and these in turn burst and dry up, the whole affectio lasting perhaps a week or ten days. No special treatment is require If the inner aspect of the lip is affected, the epithelium early become sodden and is shed, so that the vesicular stage is much shorter.

FIG. 295.—CHRONIC EPITHELIOMA OF LOWER LIP. (FROM A PHOTOGRAPH.)

Mucous Cysts occur o the inner side of the lip i the form of small rounde swellings, which are trans lucent and contain a glair fluid. They are often du to trauma, whereby th opening of a mucous glan is blocked. The whole cys wall should be dissecte out, and the wound close by stitches.

Nævi are frequently me with in the lip. If confine to the inner aspect the may be dissected out, bu when large and involvin the whole thickness, th should be dealt with l electrolysis.

Warty Growths are of seen on the lower lip, es cially near the angle, t may then simulate epi lioma. They are dis guished, however, by fact that ulceration is not often present, that the lymphatic gl are not involved, and that there is but little infiltration of the They should, however, be removed as early as possible, malignant disease often starts from them.

Epithelioma of the lip usually occurs in men of the working cl and is commonly stated to be due to the irritation produc smoking a short clay pipe, which is allowed to rest on one other side near the angle. A semicircular notch will freque noticed in the teeth of the upper and lower jaw, correspondin situation of the growth on the lip, and caused by the consta tion of the pipe-stem. It may also start opposite the site projecting rough or carious tooth. It is but rarely met women, occurring in England in not more than 5 to 6 per the cases, and of these, according to Hutchinson, half are

smokers. It is also more common amongst country folk who use the short clay pipe than amongst the cigarette and cigar smokers in towns.

The disease may start as an induration around a crack or fissure, which gradually extends, forming a typical malignant ulcer; or as a wart-like growth, which fungates and ulcerates; or as a chronic infiltration leading to an irregular nodulated thickening of the lip, which sometimes looks shrunken and feels sclerosed (Fig. 295).

If allowed to run its course unchecked by treatment, the disease steadily progresses, forming an ulcerated mass of greater or less size, and even involving the jaw. The submental and submaxillary glands are early implicated, and secondary deposits are also found in the glands which accompany the carotid vessels. Beyond this, however, the disease rarely extends, visceral complications being uncommon. When a fatal issue results, it is generally caused by the secondary growths in the neck, which attain considerable dimensions and then ulcerate, this stage being possibly preceded by one of cystic degeneration. From these ulcerating surfaces a variable amount of discharge escapes, varying with the septicity or not of the wounds. Hæmorrhage is also likely to follow from erosion of some of the vessels in the neck.

FIG. 296.—V-SHAPED INCISION FOR REMOVAL OF EPITHELIOMA OF LIP.

The Diagnosis of epithelioma is rarely doubtful, but occasionally warty growths, or even a primary chancre (p. 805), may be mistaken for it. The clinical history generally suffices to determine the nature of the mass, as also the character of the base and the appearance of the parts; but in uncertain cases the removal of a small portion under cocaine, and its microscopic examination, are required to set doubts at rest.

Treatment.—The primary growth must be excised completely, if such be possible, and the submental and submaxillary region thoroughly cleared of lymphatic glands, whether they can be felt enlarged or not. When once the deeper glands in the neck have been attacked, they often contract such adhesions as to render their extirpation impracticable.

If the growth is limited to one part of the lip, a V-shaped wedge extending half an inch beyond it in all directions may be taken away (Fig. 296), and the wound closed, as in a case of hare-lip, without much deformity resulting. When it is more extensive considerable ingenuity must be exercised in order to make good the defect. One

plan that often gives good results is to excise the growth by a sor what larger V-shaped incision, and then to extend the labial fiss transversely to one or the other side, or to both, dissecting up th segments from the bone; the flaps can then usually be brou together, whilst the mucous membrane is united to the skin alc the margin of the new lip.

When the whole lower lip requires removal, *Syme's operation* n be performed with advantage. It consists first of all in the compl excision of the diseased lip. Two curved incisions are then ma starting from the middle line of the wound, and extending downwa under the chin, to terminate below the angles of the jaw, an inver V-shaped portion of skin between them remaining fixed to the sy physis menti to form a base of support for the new lip. The late flaps are now dissected up, raised, and united one to the other in middle line, so as to constitute the new lip, an inverted Y-sha cicatrix resulting. The elasticity of the skin in this region allo this to be accomplished, and the whole wound closed, without leavi any part to granulate. The mucous membrane should be fina stitched to the skin over the upper free margin. Healing by fi intention usually follows.

If the whole of the upper lip needs to be removed, it may restored in a variety of ways. Perhaps one of the best consists making incisions which skirt the alæ nasi on each side, and then tend outwards into the cheeks sufficiently to allow the tissues, wh they have been freed from the maxillæ by undercutting, to be dra together in the middle line. In such cases care must be taken to encroach on Stenson's duct.

The Extraction of Teeth.

Although this operation is usually undertaken by dentists, surgeons and medical practitioners have occasionally to perfor and not a little skill and judgment are sometimes required i execution. An anæsthetic may or may not be required. If m one or two teeth are to be drawn, gas or chloride of ethyl will su but when a large number require extraction at one sitting, it is to give ether or the A.C.E. mixture; chloroform should ne employed when the patient is in the sitting position. The po teeth are, of course, dealt with first, and subsequently those in Suitable forceps are required for the various teeth, and the nur fangs belonging to each must be kept in mind. Incisor and teeth are removed by a combination of traction and rotati bicuspids and molars by traction combined with lateral mo especially inwards. The forceps, after being sterilized, applied to the neck of the tooth well up under the gum, and tion should be made until a firm grasp has been taken, and has been loosened by lateral swaying.

Accidents of various types happen from time to time. T may break away leaving the fangs *in situ*, and then eacl

must be sought with root forceps and accounted for. In dealing with the first or second upper molar, it is quite possible to drive a fang upwards into the antral cavity, setting up thereby acute suppuration within the cavity. Laceration of the gum is often unavoidable, and injury to the alveolar margin may follow; but such accidents as fracture of the lower jaw or dislocation of the temporo-maxillary joint are certainly avoidable. The use of an elevator is sometimes desirable in order to remove old roots, but it is an instrument that must be used with great care.

After extraction the mouth is washed out with sterilized or carbolized water, and the bleeding usually ceases without delay. If the gum has been much torn, it should be pressed back into position by the fingers, and when the mouth is septic, it may be desirable to touch the socket over with tincture of iodine. A mouth-wash of boric acid or sanitas is subsequently employed.

Should the *hæmorrhage* continue, as in patients suffering from purpura, scurvy, and hæmophilia, the socket must be carefully plugged with a strip of gauze soaked in a styptic, such as adrenalin or cocaine; the use of perchloride of iron in this connection is undesirable. Occasionally the bleeding re-starts after two or three days, and is then due to septic contamination of the alveolus; in such cases it is usually necessary to open up the socket freely from the outer side, cutting away gum and, if need be, bone, so as to allow free exit to discharges and a more ready access for strips of gauze soaked in styptics or antiseptics.

Affections of the Gums and Alveolar Processes.

Spongy Gums are not unfrequently met with as a result of the administration of mercury, or from scurvy. They are characterized by being soft and congested, bleeding readily on pressure, and perhaps showing signs of ulceration. All that is necessary is the correction of the determining cause and the use of an alum mouth-wash.

Alveolar Abscess (Fig. 297) is almost always associated with suppuration around the fang of a carious tooth. The alveolar walls become expanded, and the pus finds its way over the edge of the bone (C, D), or even through the osseous tissue (A), under the external periosteum. If limited in extent, it perforates the gum directly, and is then known as a gum-boil; but it occasionally burrows beneath the periosteum, which is stripped from the bone, and may thus lead to an abscess of larger size, possibly resulting in necrosis of the jaw. The formation of an alveolar abscess is almost always associated with a considerable amount of pain of a very irritating nature, and when extensive may give rise to serious constitutional disturbance. Occasionally graver complications ensue; thus, in the upper jaw the antrum may be opened, and suppuration in this cavity follow, whilst in the lower the abscess may travel downwards and burst externally, either close to the lower margin of the bone or in the neck. A troublesome sinus results, which can only be cured by the removal

of the tooth, and even then a depressed and adherent cicatrix ensues, which is very unsightly. The most essential point in the *treatment* necessarily consists in the removal of the offending tooth. Often this is quite sufficient, and possibly the tooth may come away with an abscess cavity attached to one of the fangs. When suppuration occurs beneath the periosteum, the pain can at first be relieved in measure by fomentations, but as soon as fluctuation is detected an incision should be made through the mucous membrane, and the cavity emptied. Possibly it may be wise to keep a small piece of stuffing in for a few hours, but if a large enough opening has been made, all that is subsequently required is repeated and frequent irrigation, preferably with peroxide of hydrogen. If a small sinus

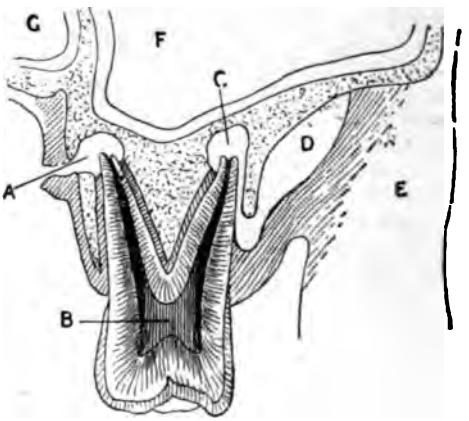


FIG. 297.—DIAGRAM OF ALVEOLAR ABSCESS, RESULTING FROM DISEASE OF MOLAR TOOTH. (AFTER THE AMERICAN SYSTEM OF DENTISTRY.)

A, Abscess arising from escape of septic material from B, the pulp chamb through the foramen at apex of the fang; it has burrowed directly throu the alveolar process and burst through the gum; C, similar abscess, wh has tracked down between the tooth and the alveolus, and spread beneath the alveolar periosteum at D, constituting the typical alve abscess; E, cheek; F, antrum; G, nasal cavity.

persists after removal of the tooth, it must be opened up, and carious or necrosed bone removed.

Pyorrhœa Alveolaris (or **Riggs' Disease**) consists in an inflamma condition of the margins of the gums, accompanied by a muco-p lent discharge, which arises from pockets or pouches which extend a greater or less distance along the roots of the teeth consequence of this the tissues of the gums shrink, and, to with the alveolar border, become atrophic; the fangs are t uncovered and the teeth loosened, so that after a while a cure is established by the patient becoming edentulous. The is limited to a few teeth, or may involve many. It is always p by an excessive deposit of tartar, beneath which bacterial

occurs, the inflammation spreading down along the periodontal membrane. *Treatment* consists in the removal of the tartar and the application of astringents and antiseptics, preferably peroxide of hydrogen, not only to the exposed mucous membrane, but also into the pouches and pockets where pus collects. Treatment is often prolonged and tedious, but must be persisted in, not only to save the teeth, if possible, but also to prevent or remedy the toxæmic and dyspeptic symptoms which are due to the absorption of pus. In many cases, however, the teeth have to be sacrificed.

We desire here to emphasize strongly the importance of dealing effectively with all sources of *oral sepsis*, as also of similar conditions involving the nose and its accessory sinuses. Not only are such lesions locally dangerous, but the constant absorption of toxic material leads to various types of anæmia (including the pernicious variety) and to some forms of neuritis; it is also conceivable that the infection of the upper part of the digestive tract with virulent organisms may explain the origin of gastric ulcers, and possibly also of appendicitis.

Hypertrophy of the Gums is met with in the form of a sessile overgrowth, sometimes almost cauliflower-like, around and between the teeth, which are usually carious; it occurs most frequently in children, but occasionally in older subjects. In slight cases the overgrowth may be destroyed by the application of a crystal of trichloracetic acid; but in the more exaggerated types excision is required.

Dental Cysts are by no means uncommon, resulting from the irritative effects of dental caries; hence they follow the distribution of that affection, and are most frequently seen in connection with the upper first molars and bicuspids. They develop at the roots of the teeth, causing a painless regular expansion of the bone, free from inflammatory phenomena, unless infected secondarily with bacteria. After a time the centre of the swelling softens, and, as the bony wall is absorbed, parchment-like crackling can be felt; finally, the condition presents as a rounded tense elastic swelling, around the margins of which the remains of the expanded bone can be detected. In the upper jaw they often encroach on and project into the antral cavity, but are not connected with it. The tooth which is the cause of the trouble is always dead, and frequently merely a septic root is present.

The *cause* of these cysts is probably the proliferation of certain embryonic remains of the enamel organ, brought about by the irritation of septic matter which has escaped from the pulp cavity. These fœtal residues are lighted up into activity, develop into masses or cylinders of epithelial tissue, and then undergo cystic degeneration. Their pathogenesis is practically identical with that of the epithelial odontome, but merely one cyst develops here instead of many. The fluid contained therein is thick and mucoid in character, and broken-down epithelial cells and cholesterine are seen in it on microscopical examination.

Treatment.—The cyst must be laid freely open into the mouth, the septic tooth or stump removed, and the anterior wall of its alveolus

cut away. The alveolus and cyst thus laid into one c scraped so as to remove all the epithelial lining, and pa gauze so as to ensure healing by granulation. In the upp utmost gentleness is required in dealing with the deeper w cyst, as the septum between it and the antrum may be thin and entirely devoid of bony tissue.

Epulis.—By this term is meant a tumour growing alveolar periosteum. Two varieties are described, viz., t and the malignant.

A **Simple Epulis** is usually of a fibromatous nature, and from either jaw, though more commonly from the low generally du irritation of teeth, and most marke outer aspect, i between the t is also foun inner side. I as a red fles smooth, or lobulated (Fi an elastic co and possibly a with a litt ficial ulcerati covered with membrane, contain a few of bone. The consists in the growth with the t stumps with

FIG. 298. - SIMPLE EPULIS.

is connected. If small, it will suffice to cut away and sc bone from which it arises; but if large, or if it recurs a treatment, the portion of the alveolus from which it springs be excised. This is best accomplished by extracting a tooth side of the tumour, and cutting vertically through each so a saw, the two incisions being united below with a chisel, remove a quadrangular portion of bone without interfering continuity of the jaw.

Malignant Epulis. This title is applied to a myeloid growing from the medullary substance of the alveolar pro forms a soft rapidly-increasing mass of a dusky purple colo runs on to ulceration or fungation. The deeper portion growth may contain an ossific deposit. As with all forms of growth, it is only locally malignant. *Treatment* consists removal of the mass and of the portion of alveolus from

arises. In the upper jaw this sometimes necessitates excision of the complete palatal segment of the maxilla, but in the lower jaw it is generally possible to maintain the continuity of the mandible by removing merely a quadrilateral portion in the same way as for a simple epulis.

Epithelioma and **Sarcoma (round or spindle-celled)**, arising from the gum, are both occasionally met with. Epithelioma in this situation rarely fungates, but rather tends to invade the bony tissues, and in the upper jaw extends upwards to the antrum; hence it is sometimes termed a 'creeping or burrowing epithelioma.' The ordinary signs of this disease become evident, lymphatic glands are enlarged, and typical ulceration of the gum follows. The only possible *treatment* consists in free excision of the growth, together with the portion of bone affected.

Necrosis of the Jaw.—Causes: (1) Subperiosteal alveolar abscess, connected with dental caries. (2) Traumatism, such as blows on the jaw, with or without fracture, in the latter instance being due to septic periostitis or osteo-myelitis, owing to the lesion becoming compound The use of dirty forceps or elevators in extracting a tooth may similarly light up an infective inflammation, resulting in necrosis. (3) In tertiary syphilis necrosis also occurs, affecting most frequently the palate or alveolar borders. (4) It occasionally results from mercurial poisoning, but rarely at the present day. (5) Phosphorus necrosis is met with amongst those who work in lucifer-match factories, but only when ordinary phosphorus is used; the amorphous form is harmless. The fumes are supposed to gain access to the jaws through carious teeth, giving rise to a somewhat acute inflammation, which terminates in necrosis. A considerable amount of new bone forms beneath the periosteum, and the sequestrum, which is curiously gray and porous, like dirty pumice-stone, is always slow in separating. Either jaw may be affected, but perhaps the lower a little more commonly than the upper. (6) Necrosis may follow one of the exanthemata, arising as an infective idiopathic or embolic osteo-myelitis, and then probably affecting a considerable extent of bony tissue, possibly the whole mandible. (7) Tubercle is occasionally responsible for this condition.

The symphysis menti in children is occasionally the seat of a pyogenic or tuberculous infection, previous to the eruption of the permanent incisors. An abscess forms, and caries, or a limited necrosis results. In a case of this type an opening is required in the submental region, through which the diseased tissue can be thoroughly scraped away. The teeth are of course lost, but a good result, and with but little scarring, may be anticipated.

The **Clinical Phenomena** associated with necrosis of the jaw are necessarily much the same whatever the cause. The acute form commences with severe pain in and around the jaw, followed by great swelling of the face and difficulty in opening the mouth or taking food. The temperature is raised, and even rigors may be present; the breath is usually foul. Sooner or later an abscess forms, which may point either in the mouth or on the face, or the pus may burrow downwards for some distance into the neck. Sinuses persist,

discharging the most offensive pus; a new case of bone sometin forms in the lower jaw, enclosing the sequestrum, but in the up this is rarely noticed, and even in the lower it is not unusual to a considerable amount of bare or dead bone absorbed without formation of an involucrum.

Treatment.—In the early stage the mouth should be fomented, as soon as there is any suspicion of pus a free incision is made do to and along the bone. When necrosis is present, it must be trea in the ordinary way, the sinuses being flushed out with an antise solution three or four times a day until the sequestrum is loose; is then removed, if possible, from within the mouth. Drainage means of an external opening is often absolutely necessary. In worst cases necrosis may extend from the middle line of the mandi to the temporo-maxillary articulation; it is then wise to make external incision, and remove the bone *in toto* after detaching it saw from the other ramus.

Affections of the Antrum.

Suppuration within the Antrum (*empyema of maxillary sinus*) f quently arises from disease connected with the fangs of the fi or second molar or bicuspid teeth; it not uncommonly extends fr the nasal cavities in connection with disease of the middle turbinat bone, or may be secondary to suppuration within the frontal sinu it is occasionally lighted up by injury. In chronic cases it is unusual to find the antrum filled with soft polypi.

The **Symptoms** produced are often extremely equivocal, and condition may be present for some time without being recogni In the *chronic* forms all that is noticed may be an intermittent charge of pus into and from one side of the nose, associated perh with some pain in the infra-orbital region, a chronic cough, an irritable throat. The pus varies considerably in amount character, being sometimes extremely offensive. On holding patient's head forwards, it can be demonstrated that there is an flow of pus into the nostril, and sometimes when the patient rec it flows back into the pharynx. Should the opening into the become blocked, all the symptoms are aggravated, the pain beco more marked and the swelling increasing. *Signs of distension* o cavity may also be produced in this way; such are manifest four directions: (*a*) Inwards, causing obstruction to nasal respir and possibly epiphora, from compression of the nasal duct; (*b*) wards, leading to protrusion of the eyeball or exophthalmos; (*c*) wards, resulting in depression of the side of the palate, and po irregularity in the line of the teeth; and (*d*) outwards, giving r a somewhat characteristic projection of the cheek beneath the eminence. Under these circumstances, a finger inserted int mouth, between the cheek and the bone, will detect a loss of resis in the anterior wall of the antrum, and if the distension has long, eggshell-crackling may be noticed, or the whole anterior

may be absorbed and an elastic swelling take its place. Infra-orbital neuralgia is often a marked feature in these cases.

In *acute* cases all the above phenomena may be present in an accentuated degree, accompanied by severe tensive pain and some amount of febrile disturbance. Necrosis of the lining bony walls may also be induced, owing to the fact that the mucous membrane is closely adherent to the periosteum.

The **Diagnosis** of suppuration within the antrum is not always easy. The periodic discharge of pus from the nose is suggestive, as also the presence of a dead or painful molar or bicuspid tooth. If a flow of pus can be induced by change of position of the head, it is pathognomonic of suppuration within one of the accessory sinuses connected with the nose, probably of the antrum. If, after the nose has been cleared and the head hung down, pus is seen welling up from under the middle turbinal, the diagnosis is almost certain. *Transillumination of the antrum* may confirm this opinion. A small electric lamp is placed within the mouth, and if the patient is in a dark room, and his antra are normal, the cheeks, lips, and lower margins of the orbits become of a rosy-red colour. If, however, the cavities are occupied by pus, blood, or a growth, the parts remain dark. Transillumination does not answer in every individual, and hence the value of the test is much diminished. The presence of illumination excludes intra-antral growths or abscess, but its absence, unless unilateral, is not of much significance. Finally, the antrum may be punctured with trocar and cannula through the canine fossa, and an absolute diagnosis obtained.

The **Treatment** necessarily varies with the type of the disease. In the early active form that sometimes follows the extraction of a tooth, and may even be associated with the pushing up of a broken fang into the cavity, it will probably suffice to enlarge the opening in the alveolus with a suitable antrum drill. A solid rubber plug is introduced, and the cavity washed out into the nose with sterile salt solution two or three times a day, until the purulent discharge ceases, when the opening may be allowed to granulate. The solid plug is better than a hollow tube, which permits discharge to get into the mouth, and food or septic material to pass into the nose.

In the more chronic cases, when the mucous membrane is thickened and infiltrated, and possibly polypi are present, a more extensive procedure is required. The antrum is opened by gouging through its anterior wall above the first molar after dividing the mucous membrane. If this tooth is present, it may advisably be drawn, and the anterior wall of its socket cut or gouged away. A sufficient opening must be made for the admission of the finger, so as to allow the interior of the cavity to be thoroughly explored and curetted. It is also important to deal with any intranasal mischief that is present, and if need be the anterior half of the middle turbinal must be removed so as to give a free exit into the nose for discharge, and to permit of thorough irrigation. It is sometimes possible to close the

crackling of the anterior wall, or even distinct fluctu
observed. It was formerly supposed to arise from ob
aperture into the nose and retention of secretion, bu
due to a cystic tumour forming from the glands
membrane, or more often to a dental cyst (p. 811)
croached on the antral cavity. The *treatment* requi
thoroughly the cyst from the mouth after dividing the
brane, subsequently removing a sufficient portion of th
to enable it to be washed out and drained. It is some
to do this without wounding the lining membrane of t

Various **Tumours** may originate in the antrum, *e.g.*,
fibromata, odontomata, osteomata, sarcomata, and
limited to the cavity, they produce no definite sym
when large enough to cause expansion of its wal
growths, however, usually pass beyond the limits of th
lead to the usual signs of malignant disease of the upp
ment consists in removing simple growths, if possible,
fering with the integrity of the maxilla. This may be
by reflecting the overlying cheek, as in excision of t
For malignant tumours, removal of the whole bo
possible remedy.

Tumours of the Upper Jaw.

Many of the **Simple Tumours** springing from the u
been already described amongst those involving the a
and antrum. Only a few remain to be dealt with.

Osteoma occurs either in the form of a tumour
compact tissue, then usually growing within the an
occasionally met with as a diffuse symmetrical ov
stituting the condition known as *leontiasis ossea*. A

irregular bony protuberances projecting beneath the skin, and when affecting the maxillæ and mandibles leading to an extremely repulsive appearance of the individual. Sometimes merely the cranial bones are affected, at other times only the jaws, whilst occasionally the whole skull participates in the change, which is almost always symmetrical. As growth progresses, the new bone encroaches on the cavities of the skull, so that the antrum may be obliterated, the eyes may protrude owing to the contraction of the intra-orbital space, and even coma and death may supervene from cerebral compression. Prior to this, however, a variety of symptoms, especially neuralgia, may be induced by pressure on the cranial nerves. *Treatment* is only occasionally possible, and consists in the removal of the projecting masses of bone by the chisel.

Malignant Disease of the Upper Jaw occurs in the form of sarcoma or cancer. *Sarcoma* is perhaps the more common, and originates either from the anterior wall, from the cavity of the antrum, from the spheno-maxillary fossa behind the bone, or may extend into the maxilla from the naso-pharynx. Not unfrequently these growths have a considerable ossific basis, and this is sometimes so extensive as to obliterate the antral cavity, and convert the bone into a solid mass. *Cancer* develops in the form of squamous epithelioma, springing from the gums; or as a columnar or acinous cancer starting in the glandular tissue, found both in the nasal and antral cavities.

The **Clinical Features** of both forms of malignant disease are practically identical.

If arising *from the anterior aspect* of the bone, a tumour is produced which projects under the cheek, the tissues of which are invaded by it; it extends down towards the mouth, and is readily detected through the mucous membrane. It may, however, spread deeply, and in time involve the cavity of the antrum. It causes no obstruction to nasal respiration, and no epiphora except in the later stages.

If it originates *within the antrum*, the usual signs of distension of that cavity are produced, associated with a foul, and often blood-stained, discharge from the nose, within which the ulcerated surface of the growth may be seen. Epiphora is caused by pressure on the nasal duct, whilst the growth has been known to burrow upwards along this passage and project near the inner canthus. The passage of air through the nose on that side is also impeded, and the palate may be depressed.

If the growth commences *behind the maxilla*, it usually springs from one of the walls of the spheno-maxillary fossa, or from the base of the skull, and is then characterized by a great tendency to spread in all directions. It may push the whole bone bodily forwards without encroaching upon the antrum; sometimes it finds its way outwards to the pterygoid fossa through the pterygo-maxillary fissure, or inwards to the nose through the palatine foramen, or even up into the orbit; whilst more rarely it spreads down along the posterior palatine canal, so as to appear at the postero-external

corner of the palate; in the later stages the antral cavity is involved, and even the base of the skull eroded.

The **General Signs** of a malignant growth of the superior m consist in the appearance of a tumour which, in its earlier stages produce various effects, but finally tends to destroy the bon occupy the whole of the maxillary region (Fig. 299). It is usually a panied by nasal obstruction, epiphora, and frequently by a disc of blood or pus from the nares. Severe pain sometimes accom the process, especially affecting the second division of the trige Neighbouring lymphatic glands become enlarged, more esp in the carcinomata; those in the submaxillary region are first inv and afterwards those in the anterior triangle; secondary depo the viscera may also occur somewhat later. The tumour f a typical malignant course, and, owing to the great vascular the parts, its onward progress is very rapid.

FIG. 299.—OSTEO-SARCOMA OF THE UPPER JAW.

The **Diagnosis** of malignant disease of the jaw from a simple tu should be readily made; the later age at which it usually ap the rapidity of its growth, the greater pain and more abu discharge from the nose, the associated enlargement of the lym glands, and the tendency to spread to and encroach upon surr ing structures, all point to malignant disease. In some cases, ever, an exploratory incision is required to make certain c diagnosis. More frequently the existence of a tumour at all some time entirely overlooked, some one prominent symptom, as neuralgia or epiphora, being treated without ascertaining the Transillumination (p. 815) may assist in clearing up the diagno

Treatment consists in free removal of the growth, if suc practicable, together with total or partial ablation of the su

maxilla. Where, however, the tissues of the cheek have been invaded, or where the growth has spread beyond the limits of the antrum, the surgeon may well hesitate before recommending an operation, since complete eradication is always a matter of uncertainty and difficulty, and often secured only at the expense of terrible mutilation and considerable risk to the patient's life. Of course, in those cases which spring from behind the maxilla, operative treatment should never be lightly undertaken.

Excision of the Superior Maxilla varies somewhat in different cases according to the character and extent of the disease.

The patient's head and shoulders are well raised, and anæsthesia is maintained by means of chloroform given by Junker's apparatus. Preliminary tracheotomy is scarcely necessary or desirable if good assistance is to hand. The proceeding may be described in stages as follows:

Stage I.: Incision and Reflection of the Soft Structures of the Cheek.—The central incisor tooth of the affected side having been extracted, the upper lip is divided in the middle line; the incision is carried round the ala and along the side of the nose, to a point half an inch below the inner canthus; it thence extends along the lower orbital margin to a point below its outer border, or even to the zygoma (Fig. 300, A). The flap thus marked out is raised from the bone, and reflected outwards so as to clear the zygomatic eminence, and the more important arteries secured, as they are divided, by Spencer Wells' forceps.

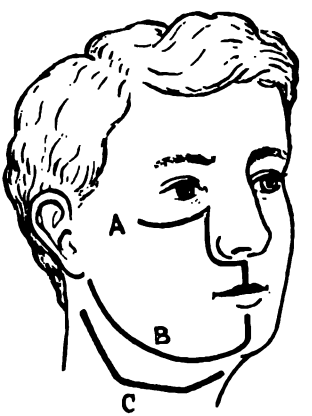


FIG. 300. — A, INCISION FOR REMOVAL OF SUPERIOR MAXILLA; B, FOR REMOVAL OF LOWER JAW; C, FOR REMOVAL OF TONGUE.

Stage II.: Division of the Bony Attachments.—A keyhole saw is passed into the nose, and the alveolus and hard palate divided from before backwards through the empty socket of the central incisor tooth. The side of the nose is then freed from its bony attachments, and the periosteum stripped up from the floor of the orbit. The nasal process of the superior maxilla is now cut through with a saw, and also the malar bone divided so as to open into the spheno-maxillary fissure. The surgeon then takes a pair of long-handled cutting-pliers, and completes the division of each of these bony attachments, but reversing the order, dealing with the malar bone first, next with the nasal attachments, and finally with the palate. The cutting-pliers must always be applied with the smooth surface towards the tissues which are to be left, and the bevelled surface towards the part which is to be removed (Fig. 301). When the section of the palate is completed, the cutting-pliers are used as a lever to prise the bone out of its bed, the sound bone acting as a fulcrum, the

posterior attachments being thus fractured. The pterygoid pro
are broken through close to their origin from the sphenoid, a
lateral mass of the ethmoid yields along the inner orbital mar

Stage III.: Removal of the Bone and Tumour.—The bone i
seized by lion forceps, one blade holding the alveolus, and the
the infra-orbital border; the mouth is gagged open, and th
palate, if free from disease, is divided from its attachment to th
by a transverse incision, and all other connections being sever
bone is removed. Considerable hæmorrhage may occur at this
from the infra-orbital and posterior palatine vessels; it is c
temporarily by plugging the wound firmly with a sponge, an
sequently the chief vessels are secured by ligature, whilst s

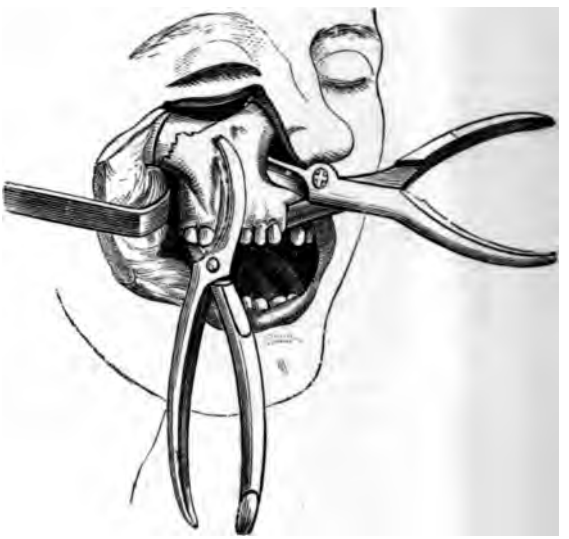


FIG. 301.—EXCISION OF THE SUPERIOR MAXILLA.

bleeding-points may be touched with the cautery. Any or
portions of the tumour are now dealt with, and the cavity
being dabbed over with a solution of chloride of zinc (40 gra
the ounce), is plugged with strips of sterile gauze. The wo
the cheek is closed, the greatest care being taken to obtain ac
apposition of the flap, especially at the lip margin, and dresse
gauze secured with collodion.

In the majority of cases there is comparatively little shoc
the patients do remarkably well—at any rate, for a time—alth
unfortunately, recurrence is only too likely to follow. The pl
the nose is left *in situ* for twenty-four hours and then removed th
the mouth, and the wound irrigated with some antiseptic sol
The plug may be replaced, but can usually be dispensed with

patient washes out the cavity several times a day. Healing is effected by granulation, and of course a large gap communicating with the mouth remains. This can be subsequently remedied by an obturator, to the upper surface of which is attached a plug or cheek-plate to prevent falling in of the cheek, and to diminish the cavity of the nose. The patient is fed for the first few days by the rectum, or by a tube passed into the pharynx, but soon acquires the knack of swallowing fluids, especially when the soft palate has been left intact.

Although malignant disease must always be removed with a free hand, yet the amount of deformity caused by a complete extirpation of the maxilla is not inconsiderable, and whenever it is justifiable, the operation should be limited, and no more bone removed than is absolutely essential. In particular, the floor of the orbit should not be needlessly sacrificed, as its removal always involves displacement downwards of the eye, and possibly diplopia. To effect this, the nasal portion of the incision is alone required; the alveolus and hard palate are divided, and then a saw is carried longitudinally outwards from the nares across the bone (*i.e.*, through the antrum) just below the orbital plate. The posterior connections are dealt with as before. Occasionally a still more limited proceeding may suffice for the removal of an alveolar growth, whilst the upper part of the bone can be taken away without the lower. For these proceedings text-books of operative surgery must be consulted.

FIG. 302. DENTIGEROUS CYST, SHOWING EXPANDED CONDITION OF THE LOWER JAW, AND UNERUPTED TOOTH LYING HORIZONTALLY WITHIN IT. (COLLEGE OF SURGEONS' MUSEUM.)

Various forms of osteoplastic resection of the superior maxilla required for the treatment of tumours of the naso-pharynx are mentioned later (p. 839).

Tumours of the Lower Jaw.

These are similar in character to those met with in the upper jaw. Thus, **Chondroma, Osteoma, Fibroma,** and the simple and malignant forms of **Epulis,** have been already described.

Dentigerous Cysts form around teeth which are so misplaced that they cannot erupt; though occasionally seen in the upper jaw, they

are much more common in the lower. Their characters and have been already described under the title of *follicular odonta* p. 199. They are met with in young people, and give rise pansion of the jaw (Fig. 302); the tumour thus formed is hard and solid to the touch, but later on eggshell-crackling an true fluctuation are observed when the encasing wall has l thin or absorbed. Irregularity in the line of the permanen may sometimes be noted, but not necessarily, since the mill corresponding to that which is misplaced is not always shed, to the absence of pressure from below. Occasionally supp within the cavity may be caused by an extension of inflam from the fang of a neighbouring tooth, or by the cyst being during its extraction, and a sinus discharging offensive pus w form. *Treatment* consists in freely opening the cyst throu mucous membrane, and removing a sufficient portion of th wall to allow of the removal of the misplaced tooth. The ca

FIG. 303.—FIBRO-CYSTIC DISEASE OF THE LOWER JAW.

(By kind permission of the Council of the Royal College of Surgeo

left open and allowed to heal by granulation, during which strict attention to cleanliness must be observed.

Fibro-cystic Disease of the Jaw (*epithelial odontome*, p. 199) ha already mentioned as characterized by the formation of a t often of great size, which consists of spaces lined with ca epithelium, and supposed to originate from the enamel (Fig. 303). It occurs most frequently in young people, an rule, runs a perfectly benign course, although when of large may lead to serious results. The only *Treatment* consists in co removal of the affected portion of the jaw.

Myeloid Sarcoma is met with in the lower jaw, not only in th of a malignant epulis, but also occasionally as a central g usually attacking the median portion of the bone, which bu expanded in the same way as when a similar disease invades t of a long bone. It presents but slight evidences of malignan may be treated in the first place by opening the outer shell o

and scraping away the soft contents, the cavity thus formed being swabbed out with pure carbolic acid, and plugged with gauze. Should it recur, the affected portion of the bone must be removed, although, whenever possible, a bridge of osseous tissue is left so as to connect the two segments of the jaw; if this is not attended to, they are likely to fall together, and lead to considerable trouble. If the whole thickness of the bone is excised, a wire frame or splint should at once be introduced between the fragments with the same object. It is replaced later on by a suitable plate carrying artificial teeth.

Round- or Spindle-Celled Sarcoma also occurs, usually springing from the periosteum, the deeper parts undergoing ossification (Fig. 304).

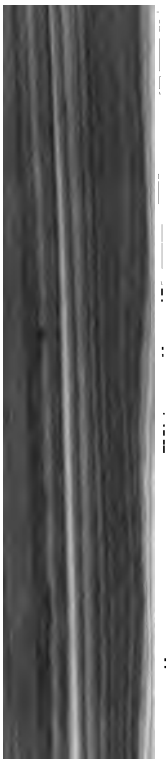
FIG. 304.—OSTEO-SARCOMA OF THE LOWER JAW.

The course is typically malignant, and free removal of the affected portion of the bone must be undertaken.

Epithelioma invades the lower jaw as an extension of a similar affection arising either from the gum, lips, or tongue. Excision of a portion of the bone together with the primary disease is always required, unless it has extended so far as to render extirpation impracticable.

Excision of the Lower Jaw is employed in the treatment of various tumours arising from that bone, as also sometimes for extensive necrosis. In the latter case it may be possible to deal with it from the mouth, but when required for the treatment of malignant disease an external incision is absolutely essential.

If the whole of one side is to be removed, an incision is made, reaching from just below the red margin of the lip downwards to a



aspect of the bone, and the cavity of the mouth opened. incisor tooth is drawn, and the jaw divided through the with a saw and cutting-pliers. By this means the ger and their attached muscles are not encroached on, or th of the tongue impaired. The bone is seized and drav and its internal connections as far as the angle divide firmly depressed, and the muscular attachments of the the outer side, and of the internal pterygoid on the inner, as also the inferior dental nerve and artery. By still fur ing the bone, the temporal tendon is exposed, and shou by successive touches of the knife, which is kept close Finally, the condyle is freed after division of the exter muscle and of the ligaments of the temporo-maxillary The proximity of the internal maxillary artery to the in the neck of the bone must be remembered. After hær been arrested, the wound is stitched together and collodion and gauze; possibly a drainage-tube may be advantage for a few days through the floor of the mouth. deformity usually results from this operation, owing to t half of the bone being drawn across the middle line.

Diseases of the Temporo-Maxillary Articulati

Acute Synovitis may supervene in the course of rheumatic fever, and is evidenced by pain on movemen and by tenderness and swelling immediately beneath th zygoma, due to effusion into and around the joint. Resol follows, but fibroid thickening of the ligaments and in movement may result.

Acute Arthritis arises from pyæmic infection after the or from gonorrhœa, but may be caused by direct extension

Osteo-arthritis is by no means a rare affection of this joint. It is often symmetrical, and characterized by an enlargement of the condyle, which can be felt distinctly in front of the tragus, especially on opening the mouth, when crepitus is also noticed. The pain is worse at night and in wet weather, and the jaw becomes deflected to the sound side if the disease is unilateral; when both sides are affected, the jaw is pushed forwards, and the chin projects. The articular cartilage undergoes the usual changes, the inter-articular cartilage disappears, and the glenoid cavity becomes enlarged and flattened, so that the eminentia articularis is relatively less marked, thus permitting the external pterygoid muscle to draw the condyle forwards. After a time, considerable difficulty is experienced in opening the mouth, even amounting to ankylosis. Ordinary medical *treatment* may be used in the early stages, but in the later the condyle of the jaw should be excised, a proceeding followed by excellent results.

Tuberculous Disease may arise either in the bone or synovial membrane, perhaps spreading to it from neighbouring lymphatic glands. It runs the usual course of the disease, terminating in caries of the condyle, and ankylosis after protracted suppuration; to prevent this, excision of the condyle is indicated.

Immobility or Closure of the Jaw may be caused by a variety of conditions:

1. True ankylosis of the temporo-maxillary joint, fibrous or osseous, as the result of any of the diseases mentioned above.

2. Cicatricial contraction of the soft structures either within or without the mouth, as from burns, lupus, or extensive operations in the pterygoid region upon the roots of the fifth nerve, from cancrum oris, or very rarely from myositis ossificans.

3. Spasm of the muscles of the jaw (*trismus*), due to reflex irritation, as from carious teeth, or an unerupted wisdom-tooth, or some other local lesion. It is occasionally hysterical, and is one of the early symptoms of tetanus.

4. Local inflammatory conditions often render opening of the mouth impossible, both from the pain and swelling -*e.g.*, in mumps, parotid abscess, acute alveolar periostitis--whilst in epithelioma and various forms of tumour the size of the growth may seriously impair the mobility of the jaw.

The term ankylosis can only be applied to the conditions mentioned in the first two groups. In the others appropriate treatment must be instituted according to the character of the affection. Where the closure of the jaw is permanent, it may be due to osseous ankylosis, the bony masses extending not only between the articular surfaces, but also between the alveoli; or to fibrous adhesions within the joint; or to extra-articular contraction of the soft parts, not only the skin and mucous membrane being involved, but also frequently the muscles and deeper structures.

Division of the neck of the bone or excision of the head may thus be impracticable, or, even if possible, is useless, since the muscles of the jaw hold the surfaces in such good apposition as to bring about

a recurrence of bony union, unless obviated by implanting a flap the temporal muscle or a vulcanite plate between the bony surfac Division of the intra- or extra-buccal cicatrices is unsatisfacto owing to their rapid re-formation. The best *treatment* in most ca is either removal of the vertical ramus of the jaw down to the le of the alveolus, or the plan suggested by Esmarch, viz., excision a wedge of bone, with its apex towards the alveolar border, from neighbourhood of the angle, and the establishment of an artifi joint at that spot. The incision should be made below and beh the angle down to the bone, from which the periosteum is strip up, and division is accomplished by means of the saw.

Excision of the Condyle of the Jaw is not always a simple ope tion, since the space at the surgeon's disposal is limited by zygoma above, the facial nerve below, the parotid gland in fr and the external ear behind. The best incision is a curvilinear o commencing over the middle of the zygoma, and passing downwa in front of the tragus. It should merely divide the skin and s cutaneous tissue, and the flap thus marked out is turned forwa A transverse incision is now made through the deep fascia i mediately below the posterior extremity of the zygoma, extend down to the neck of the bone, which is cleared by a raspatory s divided by cutting-pliers; the condyle is then grasped by necr forceps, and twisted out. But little bleeding occurs, and the wo heals by first intention except along the track of the drainage-tu which should always be employed.

CHAPTER XXVIII.

AFFECTIONS OF THE NOSE AND NASO-PHARYNX.

Affections of the Outer Nose.—Several forms of **Injury**, including fracture of the nasal bones and separation of the cartilages, have been already noticed (p. 478).

Depression or **Flattening of the Bridge of the Nose** is either a result of traumatism, such as a fracture of the nasal bones, or may arise from defective growth of the ethmo-vomerine septum, due to disease either of syphilitic or tuberculous origin early in life, whilst it may also result from similar conditions occurring in the course of tertiary syphilis. If caused by injury, and dealt with promptly, it may be remedied; but when once acquired, and especially if the consequence of disease, treatment is much less satisfactory. Several cases have been recorded, however, in which bone-grafting has been successful. An incision is made down the middle line of the nose, the soft parts are reflected on either side, and, after making a comfortable bed for it, the bone-graft is introduced, and kept in position partly by sutures, but mainly by closing up the wound in the soft tissues. In one case the patient's own fourth metatarsal bone was utilized with success, whilst platinum, gold, or celluloid frames have also been employed in the same way.

The subcutaneous *injection of paraffin* has been utilized in many of the worst cases with advantage. A paraffin is employed which melts at 110° F.; this is slowly injected into the subcutaneous tissue through a specially adapted syringe. Whilst still fluid, it can be moulded into the required shape, but careful pressure has to be exercised to prevent it from spreading into the eyelid or cheek, where it would form an unsightly bulge. The paraffin is supposed to remain permanently as an infiltration of the tissues, but further experience is required to make sure that this is the case.

Expansion of the Bridge of the Nose is always the outcome of some long-continued intranasal pressure, especially from the growth of polypi. It rarely follows the development of mucous polypi, except when they are very large and chronic, but it is not an uncommon accompaniment of the fibrous or fibro-sarcomatous variety. The bridge is flattened and bulged out on either side, giving the face an appearance justifying the name 'frog-nose' which has been applied to it.

Congenital swellings at the root of the nose are not altogether uncommon, and consist either of a meningocele (p. 742), or of a dermoid cyst which may have a deep connection between the nasal bones with the cerebral membranes. It is not always advisable to deal with them in the early years of life, since their intracranial connections may be shut off as the child grows up.

It is impossible to discuss all the different affections of the **skin of the nose**. Many of them are associated with the sebaceous glands, which in this region are very large and abundant. Thus, *acne* is commonly met with, arising from an inflammation of the glands after obstruction to their ducts. It is especially frequent in drinkers and dyspeptics, women addicted to tea-drinking often suffering severely. When the superficial capillaries become markedly dilated and the face readily flushes on the imbibition of hot or stimulating fluids, the term *rosacea* is attached to it, whilst if acne pustules are also present, it is known as *acne rosacea*. Sometimes the spots become much enlarged, and there is a considerable amount of infiltration of the base, a condition described as *acne hypertrophicum*. In the most exaggerated stage the sebaceous gland become overgrown and form large protuberant nodular masses projecting from the end of the nose, and covered with red greasy skin, in which the dilated orifices of the glands are very evident, and with dilated capillaries coursing freely over them. This condition is generally known as *lipoma nasi*, *rhinophyma*, or *hammer-nose* (Fig. 305). The **Treatment** of simple acne consists in correcting the dyspepsia, and limiting the amount of, or interdicting entirely, alcohol or tea. Capsules of ichthyol (3 to 10 minims) may also be administered thrice daily, and soothing applications should be used locally, such as a lotion consisting of calamine, oxide of zinc, and precipitated sulphur, held in suspension with glycerine and lime-water. Dilated and unsightly capillaries may be dealt with by puncturing them with the galvano-cautery or an electrolytic needle. Rhinophyma requires operative proceedings; the protuberant mass should be freely dissected away from the cartilages, and the raw surface either left to cicatrize, or dealt with by Thiersch's method of skin-grafting.

Fig. 305. Rhinophyma, or Hammer-nose. (Tillmanns.)

Partial or Total Destruction of the Nose may result from traumatism but usually from some chronic inflammatory or malignant growth such as lupus, tertiary syphilis, or rodent ulcer. Epithelioma sometimes attacks it, and requires total removal of the nose for its cure. In any of these conditions the resulting deformity is so repulsive that the surgeon is certain to be asked to undertake some proceeding to remedy it. Indian surgeons have had a good deal of experience

in this direction, since in that country cutting off the nose is often resorted to as a means of avenging some real or fancied wrong. Various plastic operations have been devised, which, however, we can only indicate briefly here, referring students to larger works of operative surgery for fuller details.

The chief methods of **Rhinoplasty** are as follows:

1. The so-called *Indian method* * consists in the formation of a nose from a flap of skin obtained from the forehead. The flap (Fig. 306) is more or less pyriform, with the pedicle so placed as to contain one of the frontal arteries and the supra-trochlear nerve. Necessarily its exact shape and size vary with the character of the defect and with the type of nose desired. Keegan, who has done some excellent work in this direction, advises that the skin covering the nasal bones, as high as the level where the bridge of spectacles would rest, should first be turned down in two flaps, using their attachment to the nasal mucosa as a hinge, so that the cutaneous surface shall look inwards and the raw surface outwards. Over these the forehead flap is placed, and there should be sufficient tissue in the nasal flaps to enable their free ends to be stitched below to the forehead flap on either side of the columna, thus completing the anterior nares. The columna itself is formed by the free end of the forehead flap. Drainage-tubes are inserted through the anterior nares and kept in position for ten to fourteen days. The lateral margins of the flap are carefully sutured to the freshened edges of the defect. When the union of the lower portion is sufficiently firm, the nose is made more shapely by partially dividing the twisted pedicle, but if possible the integrity of the frontal artery should still be retained. The wound in the forehead is drawn together as far as possible by sutures, and healing promoted later by skin-grafting.

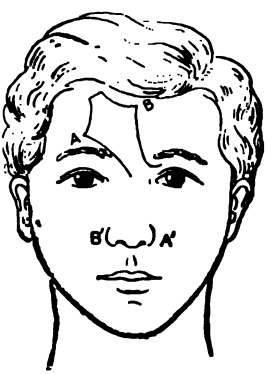


FIG. 306. — INDIAN METHOD OF RHINOPLASTY, SHOWING THE SHAPE AND POSITION OF THE FOREHEAD FLAP.

The points A and B are brought down to A^1 and B^1 when the flap is twisted into position.

2. In the *Tagliacozzian or Italian operation* (so called from Tagliacozzi, the surgeon who first proposed it) a flap of skin is taken from the arm. The pedicle must always be broad, and is left attached to the upper part of the inner aspect of the arm; it must be so placed that it can be brought into apposition with the nasal defect without tension, the fore-arm and hand being fixed by a suitable apparatus above the head, and retained there until good union has been accomplished, when the pedicle is gradually divided. Absolute fixation of the arm is an essential, and as this may need to be maintained for two or three weeks, the patient needs a considerable amount of pluck and perseverance. When the pedicle has been detached, subsequent plastic measures are required to mould the new tissue to the shape of the nose.

3. The cheeks have also been made use of in what is known as the *French method* to supply material for the nose, flaps being dissected up from either side, and united in the middle line.

4. The above operations have the great objection that the new nose only consists of soft tissues, and hence is very likely to shrivel up and contract, so that all that is finally obtained is a covering for the defect, which is often quite flush with the surface. To obviate this, and to secure a bony basis for the nose, attempts have been made to utilize a finger for the purpose, and Mr. Astley

* For full details of this plan we would refer to Keegan's 'Rhinoplastic Operations.' Baillière, Tindall and Cox, 1900.

nasal cavity through the anterior nares. A good ligh
such as that derived from an electric head-lamp, and s
nasal speculum. Perhaps Thudichum's speculum is on
it consists of two unfenestrated blades, connected by
spring, which is held in the hand, whilst the blades are
the nostril, the nasal vibrissæ being thus held aside;
index fingers are placed one on each limb, so as to
amount of tension, and prevent painful overstretching.
similar means one is enabled to see the anterior part
fossæ, including the inferior turbinal and the erectile
anterior extremity. The amount of distension of the lat
view of other structures; if greatly swollen, it feels s
fluctuating, but collapses entirely on the application of
solution of cocaine, allowing the free convex border o
turbinal to come into view, as also the cleft or olfa
between it and the septum. The septum can also l
frequently showing deviations from the middle line, and
or spurs of bone or cartilage, which run in an anterc
vertical direction. A certain amount of erectile tissue is
on the septum.

The introduction of a sterilized probe under the gui
eye is of the greatest value in examining the nose.
serves to distinguish the different qualities of growth
seen, but will also give information concerning regions
surgeon's eye.

2. By *posterior rhinoscopy* is meant an examination of
nares by a mirror placed behind the uvula and soft pal
no means easy to accomplish, and requires some d
practice. The tongue should be depressed, and a s
previously warmed to prevent condensation of mois
passed behind the uvula, without touching it or the pos

vening. The inferior meatus often looks very small owing to the prominence of the velum palati, whilst the middle meatus may be encroached on by tumefaction of the erectile tissue at the back of the inferior spongy bone. Outside the choanæ are seen the yellowish openings of the Eustachian tubes, whilst above and between them Luschka's tonsil, a raised collection of lymphoid tissue in the roof of the pharynx, is occasionally observed.

3. *Palpation of the Posterior Nares* with the index finger, previously disinfected, will, however, give better results in the majority of cases to those who are not specially practised in the above method. The index finger is passed behind the uvula and velum, and the nares can then be well explored, and the existence of adenoids or other growths determined.

Foreign Bodies are rarely impacted in the nasal passages except in children, in whom the condition is not uncommon. Any unilateral purulent discharge from a child's nose should suggest the likelihood of such an occurrence, peas, beads, or buttons, being the substances usually introduced. A certain amount of unilateral obstruction to nasal respiration is caused thereby, followed by a catarrhal or even suppurative rhinitis, and in old-standing cases a rhinolith or nasal calculus may be caused by the deposit of inspissated mucus upon the outer surface of a foreign body. Removal is often effected by syringing out through the unaffected nostril, the lotion rushing back through the other side, and carrying the intruding body before it. Failing this, the child should be anæsthetized and a forceps or scoop employed, the surgeon's manipulations being guided by a rhinoscope and frontal illumination. Necessarily, all instruments used for this purpose should be thoroughly sterilized. After the removal, the nostrils are carefully washed out for a few days with a weak alkaline antiseptic lotion, such as salt and water to which a little sanitas has been added.

Acute Rhinitis.—Several distinct varieties of this affection are described.

1. The **Catarrhal** form is extremely common, constituting what is popularly known as a 'cold in the head.' Not only is the nasal mucosa involved, but the inflammation often extends to the frontal or maxillary sinuses, causing brow-ache and face-ache, whilst if it spreads to the mucous lining of the Eustachian tube, temporary deafness may ensue. In infants great dyspnœa often results owing to the extreme narrowness of the nasal passages, and this may be so marked as to interfere for a time with breast feeding. Apart from the usual domestic remedies directed to increasing the action of the bowels, kidneys, and skin, considerable relief can often be obtained by washing out the nasal cavities three or four times a day with a weak warm alkaline lotion containing borax and possibly a little menthol.

2. A **Suppurative** form arises not unfrequently as a result of acute suppuration in one of the accessory sinuses (acute empyema), and then treatment must be mainly directed to the sinus. Occasionally

merely gives a dull dullness. One of the most com
characterized by engorgement of the erectile tissue
inferior turbinated bone, causing obstruction to nasal r
an abundant discharge of muco-pus. It usually occu
with prominent noses, where the passages are narrow,
quence the air pressure is diminished; it may be lighte
slight local irritant, such as a sudden change of temp
anterior end of the inferior turbinal is swollen, red, and
mucous covering being œdematous, and the mass feelin
it with a probe, like a sac full of fluid. The local ap
5 per cent. solution of cocaine causes its complete, thou
collapse in a few moments. If it is allowed to persist
of the mucous membrane follows, and in the most m
projecting papillomatous-like mass, almost resemblin
results. It is, however, merely an inflammatory hy
not a new growth; true papillomata are extremely rar
tion. The posterior end of the bone may be similarly
the mucous covering of the middle turbinal may part
same process. A certain amount of pharyngitis or lary
may also be present. *Treatment.* — In the early stag
required is to wash out the nasal cavity night and
some simple nose lotion, such as borax or bicarbo
(5 grains to 1 ounce). This may be accomplished eith
the solution from the palm of the hand, or by using
nasal douche; Basdon's douche is perhaps the best for
If such is insufficient to give relief, or if collapse is not
cocaine, the surface may be swabbed over with some d
or, better still, a point of galvano-cautery at a red hea
along the length of the bone. In the later stages re
hypertrophied excrescences by the cold-wire snar
galvano-écraseur, is required.

pharyngitis and chronic laryngitis are often present. Both nostrils may be involved, but occasionally the affection results from deviations of, or cartilaginous excrescences (spurs) from, the septum, and then is unilateral, the discharge coming from that side which is most patulous, whilst the narrowed side remains healthy. When symmetrical, the disease is rather due to constitutional than to local causes, occurring in weakly, anæmic women, and is to be treated by general rather than local measures. In the unilateral form, deviations of the septum from the middle line must be rectified, or the spur removed by the saw. In this way the inspired air is made to pass more freely along the narrowed healthy side, and the other nostril is dealt with by the use of weak alkaline lotions. It may also be advisable to plug the dilated side with cotton-wool for some time daily, so as to enforce respiration through the other nostril. Treatment is always likely to be prolonged, and it is possible that a daily alkaline nose lotion may be needed permanently. Stimulating applications are never borne well, and hence should rarely be ordered.

Ozæna.—This term was formerly applied to any offensive mucopurulent discharge from the nostrils, whatever the cause, and thus was made to include such conditions as tuberculous or syphilitic disease of the turbinated bones or of the septum, suppuration in the accessory sinuses, the impaction of foreign bodies, or the ulceration of malignant growths. Improvements in differential diagnosis have reduced the cases of ozæna to a very small number, and the term is now limited to one particular affection, and that a special *atrophic* form of *rhinitis sicca*.

The disease is usually met with in young females, and may sometimes originate from traumatism, or after one of the exanthemata, or is associated with inherited tuberculosis or syphilis. The nose is almost always wide and roomy, and may be of the special strumous type; the lips are often thick and everted, and the mouth is usually held open owing to the impediment to nasal respiration caused by inspissated mucus. The fœtor of the breath due to the decomposition of this discharge is the special feature that calls attention to the complaint; it is peculiarly searching and objectionable, but the patient fortunately is not cognizant of it. There is not much discharge, but at varying periods large crusts come away, giving relief both to the nasal respiration and to the fœtor. Both nostrils are usually involved.

On examination, the nares are found to be unusually patulous, and the vibrissæ are scanty. The mucous membrane over the turbinated bones is dry, collapsed, and pale, so that after clearing away all the dried mucus and scabs, it is often possible to see the posterior pharyngeal wall, and even the orifices of the Eustachian tubes. The pharyngeal wall is also dry, and may be coated with a film of inspissated mucus. No ulceration is present, although the removal of the crusts may be associated with a slight amount of bleeding owing to their close attachment to the mucous membrane.

The examination of a case of suspected ozæna should also include the accessory cavities of the nose, since many cases in which crust-formation is a prominent symptom are really due to an empyema of one or more of the sinuses.

The chief *ætiological* factor is the wide, roomy nose, from which it is difficult to expel the exudation arising from any ordinary rhinitis, and hence the discharge tends to collect and necessarily to putrefy. For the same cause the mucous membrane becomes dry and the erectile tissue collapses, so that an atrophic form of rhinitis sicca results, followed in time by sclerosis and shrinking of the turbinated bones. It is always a prolonged process, although in the course of years it improves and gradually disappears.

Treatment.—The first essential is to keep the nose clean and free from putrefying masses of dried secretion. This must be accomplished by irrigating the cavity once or twice daily with a warm weak solution of common salt to which a little sanitas has been added. At first it is well for the surgeon to see to this himself, but after a while the patient or her friends can be entrusted with the task. Every portion of scab ought to be removed daily, and the surface lubricated with some such application as a spray of menthol and paroleine (10 grains to 1 ounce). The nose should then be partially plugged with a tampon of cotton-wool, especially along the lower meatus, and if thought desirable the wool may be medicated with some antiseptic. By this means a flow of mucus from the membrane is determined, and the discharge is thus rendered more fluid, and inspissation prevented. A similar end may also be obtained by partially plugging the nostril with an indiarubber tube, so as to diminish its size. The general health must be attended to, and patience and perseverance will generally be crowned with success. Operative measures are scarcely ever required in this disease, although they have frequently been resorted to most unnecessarily.

Disease of the Middle Turbinated Bone and Ethmoid is sometimes the cause of an offensive purulent discharge from the nose, which is often wrongly called ozæna. It occurs in individuals of all ages and classes, arising from syphilitic or tuberculous disease, but is perhaps most commonly due to septic infection from without, the result of meddlesome and careless surgery. It must be remembered that the upper part of the nose is normally sterile, and the introduction of dirty instruments is often responsible for this affection. It commences as a submucous infiltration, usually of the middle turbinal, and thence spreads, with or without ulceration, to the periosteum covering the bone, which becomes carious or necrosed. Various parts of the ethmoid, including the cribriform plate, may also be involved, and adjacent bony cavities (antrum, frontal and ethmoidal sinuses, etc.) are filled with pus. In bad cases the venous channels in the base of the skull—*e.g.*, the cavernous sinus—may be thrombosed and infected, and even abscess of the brain has followed. The disease affects one or both sides of the nose, perhaps most

ently but one. On examining the interior of the nostril, there patency of the cavity, as in ozæna, but a large polypoid mass anulation tissue may be seen blocking the middle meatus and ed with a half-dried scab, whilst pus can be seen to exude from en pressed upon; this usually comes from the antrum or frontal , the mass of granulation tissue lying both above and below the nce. A probe passed into the mass always impinges on diseased re bone.

hen due to syphilis, distinct sequestra are usually present, times involving the septum and hard palate, but the accessory ies are not generally invaded.

e **Diagnosis** from ozæna is made by remembering that in the r the characteristic features are the abnormal width of the nasal , the bilateral symmetry, the collapse of the erectile tissue, the complete inspissation of the secretion, and the pathognomonic h, which are all absent in these cases. A certain amount of r is present, but it is mainly noticed by the patient, not so much utsiders.

eatment consists in the removal of all dead and carious bone can be safely dealt with, together with the destruction of all ting granulation tissue, and the drainage of such accessory ies as can be reached, whilst attention is given to maintain liness and asepsis as far as possible. Thus, the middle tur- ted bone and its accompanying mass of granulation tissue may moved by the sharp spoon, snare, or polypus forceps. The m must, if necessary, be opened and drained, and the walls of thmoidal cells may be broken down, and exit thus given to pus. greatest gentleness and care must be exercised when any attempt ide to deal with the roof of the nose.

sal Polypi.—Two forms of nasal polypus are described, viz., imple or mucous polyp, and the fibrous or fibro-sarcomatous. r malignant tumours occur in the nasal fossæ, to which, how- , the term polypus can scarcely be extended; they mainly nate from the superior maxilla.

he **Mucous Polypus** consists of a soft gelatinous mass, which on oscopic examination much resembles myxomatous tissue, red by ciliated columnar epithelium, and supplied freely with dvessels. The general opinion of rhinologists is in favour of the that polypi are inflammatory in origin, consisting merely of matous hypertrophic tissue, sometimes dependent on, and kept y, suppuration in one of the adjacent sinuses, sometimes due to se of the underlying turbinal, but not unfrequently occurring t from any obvious lesion. They are usually situated on the dle and superior turbinals; they rarely start from the roof of the l fossæ, occasionally in the sinuses, or at the orifices leading them; they hardly ever involve the septum or inferior turbinated . The polypoid masses are generally multiple, a large one cting downwards and forwards towards the anterior nares, and ring or hiding a whole series of smaller ones, which readily

spring into prominence when that in front is removed. They are usually attached by a small pedicle, and when developing in the nasal fossa are pyriform and laterally compressed. When of large size, they may protrude through the nostrils, and then the epithelium covering the anterior portion becomes squamous, and the whole mass firmer in texture and papillomatous in appearance. Sometimes they project backwards into the pharynx, and are then more distinctly globular and usually single. Occasionally they are the starting-point of a myxo-sarcomatous growth, which develops rapidly, and early tends to invade the surrounding bones.

FIG. 307.—MUCOUS POLYPI OF NOSE, SPRINGING FROM THE BACK AND FRONT OF THE MIDDLE TURBINATED BONE.

The main **Symptom** arising from nasal polypi is obstruction to the passage of air along one or both sides of the nose, according to the location of the growths. This is always of gradual onset, and is invariably worse in wet weather, on account of the hygroscopic property of mucoid tissue. There is often a thin, watery discharge from the nose, which may perhaps be blood-stained. The patient is unable to blow the nose, and his articulation becomes nasal in quality. On rhinoscopic examination one finds a grayish semi-translucent glistening mass occupying the nostril, and attempts to blow the nose render this more obvious. Its pedunculated nature can be easily demonstrated by passing a probe around it. When of large size, some flattening or expansion of the bridge of the nose may be caused thereby, and possibly epiphora from pressure on the opening of the nasal duct.

The **Diagnosis** should present no difficulty to one who knows how to employ the nasal speculum. Abscess, a spur, or deviation of the septum, though causing unilateral obstruction, is recognised by the exercise of a very small amount of intelligence. Œdematous masses of granulation tissue, associated with tuberculous or syphilitic disease of the bones, are recognised by usually involving the septum as well as the turbinals, by the purulent discharge, by the absence of superficial epithelium, and by not being distinctly pedunculated; carious bone can usually be felt by a probe through the granulation tissue. From hypertrophy of the mucous membrane over the inferior turbinated bone, a polypus is known by the fact that it scarcely ever springs from this region, whilst the former condition is sessile and red, and diminishes considerably in size by the application of cocaine.

The **Treatment** of mucous polypi consists in their removal either by forceps or the snare. The former plan is usually condemned rhinologists as unscientific and barbarous, and as utilized by

of the old class of surgeons, such it certainly was; but if employed in the way described below, it is just as efficient as the snare, and gives the patient very little, if any, more pain. Personally, we must plead guilty to a very distinct preference for the forceps.

In undertaking avulsion by forceps, the patient is seated in a chair, and the surgeon sits or stands in front of him. The nasal cavities are well sprayed with a solution of cocaine and adrenalin, and the situation of the pedicle ascertained by inspection and by the use of a probe. The forceps employed should be long, with delicate, though strong, blades, which are deeply serrated on either side of a median groove. They are introduced open, with a blade placed horizontally on either side of the growth, and are gently pressed upwards until the pedicle is grasped as close to the turbinated bone as possible. The blades are then closed firmly, and the polyp twisted off and removed, a certain amount of hæmorrhage resulting. The same process is repeated to the smaller tumours until the nostril is clear. It may be plugged with a strip of boric lint if there is much bleeding, but such should never be left unchanged longer than twenty-four hours. The plug is then removed, and the base of the growth carefully examined and cauterized with the galvano-cautery by the aid of a nasal speculum. This cannot be so accurately accomplished immediately after removal, as the bleeding interferes with clear vision. The cauterization of the base is a most important item in the treatment, as without it the growths are sure to recur. The patient should be again examined after a short interval, so that any smaller polypi which have commenced to develop may be suitably dealt with.

To remove polypi with the galvanic écraseur or snare, a speculum is inserted, and the wire loop passed round the growth so as to encircle its base, and gradually tightened until it has cut through. This plan is specially adapted to large masses which project downwards behind the palate.

Whichever method is adopted, recurrences are not uncommon, and the treatment may in consequence be very prolonged; but if the surgeon will persevere in the way described above, the disease can in time be eradicated without having recourse to such a mutilating procedure as removal of the turbinated bones; indeed, after such an operation, considerable trouble may arise from the nasal cavity being too patulous.

A **Fibrous Polypus** is the term applied to a fibroma, which tends sooner or later to become sarcomatous, springing from the base of the skull, especially from the basi-sphenoid or basi-occipital. It is at first distinctly pedunculated, and is usually firm, smooth, and fleshy in character; when of large size, it may be lobulated. The early symptoms are almost limited to those of obstruction to nasal respiration, but to this is not unfrequently added severe epistaxis, owing to the vascularity of the capsule and of the overlying mucous membrane. As it increases in size, ulceration occurs, leading to a fœtid sanious discharge, and the growth rarely remains limited to the nasal fossæ. If pushing forwards, it may lead to expansion of the bridge of the

nose and separation of the eyes, which may even be made to diverge; but if backwards, it may depress the velum, and hang downwards as a naso-pharyngeal tumour. In other cases it may force its way into the orbit or any of the other surrounding cavities, or may even erode the base of the skull, and encroach upon the cranium. It is rare for any of these latter manifestations to occur until after the tumour has taken on a distinct sarcomatous type.

The disease usually attacks young people, and mainly those in the second decade of life. It progresses with considerable rapidity, and the fatal issue may be due to hæmorrhage, asphyxia, or cerebral complications.

Treatment.—Unfortunately, this condition is but rarely recognised in the early stages, owing to the fact that the majority of practitioners are quite unable to use the rhinoscope. We would impress upon students the immense importance of thoroughly exploring both by the mirror and the finger passed behind the velum every case of nasal obstruction or of chronic discharge from the nose. When the growth is small and polypoid, it can often be dealt with from the anterior nares by means of a galvano-écraseur. The wire loop is inserted from the front, and hitched over the tumour, so as to encircle its base, by the assistance of the right index finger passed behind the velum. The pedicle must be divided as near the skull as possible, as otherwise recurrence is almost certain to follow. Nélaton's operation, described below (p. 839), will in some instances assist the surgeon to reach the base of the skull and deal with the tumour.

In the more severe cases, where the growth has become diffuse, it is very doubtful whether much good can be done by operation, since the base of the skull is sure to be gravely affected. If treatment is attempted, one or other of the many plans for exploring the nose or naso-pharynx must be resorted to, and the operative measures must be modified according to the peculiar requirements of the case. Probably total ablation of the superior maxilla will give the best approach to the mass.

Other forms of **Malignant Disease of the Nose** are met with, and may originate in any part of the nasal fossæ. **Squamous epithelioma** is that which occurs most frequently; the symptoms consist in the presence of a blood-stained discharge, and a certain amount of respiratory obstruction, together with pain and cachexia. The lymphatic glands at the angle of the jaw are early enlarged, and the course of the disease is usually rapid owing to the great vascularity of the part. Up to within quite a recent period such growths have been almost always looked on as inoperable, but within the last few years attempts have been made to remove them, and although necessarily the mortality is great, and the liability to recurrence considerable, yet the results have been such as to encourage the practice of attacking the disease, even in such a difficult region to explore the interior of the nose.

Sarcoma may also commence in the nose itself, quite apart from that which originates in the superior maxilla. It gives rise to the usual signs of an intranasal growth, and may be dealt with

satisfactory manner by local means, such as curetting and the application of caustics. Not a few cases are on record in which such treatment has proved efficacious in curing the disease.

The **operations** which have been devised *for dealing with disease of the nose and naso-pharynx* are so numerous and complicated that it is impossible for us to mention more than a few of the most useful and important.

(*a*) In many cases of intranasal disease considerable assistance can be derived by *opening up the anterior nares*, especially when one is operating for caries or necrosis of the turbinated bones. It may suffice merely to divide one ala nasi and the attachments of the cartilages to the maxilla; but where both sides are involved *Rouge's operation* is advisable. This consists in the detachment of the mask of the face from the maxillæ by everting the upper lip and incising the mucous membrane and subjacent tissues until the nasal cavities are opened. The septum nasi is divided by cutting-pliers, and the nasal cartilages are completely separated. The soft tissues of the face can then be retracted upwards, and the nasal fossæ fully exposed. The bleeding is always considerable, and the space gained in children is but slight. When the operation is completed, the mask of the face is allowed to fall back again into position, union occurring without difficulty, although no sutures are employed.

When the upper and anterior portion of the nasal cavity is to be dealt with, Langenbeck's plan can sometimes be utilized with advantage. An incision down to the bones is made along the outer border of the nose from the root downwards and outwards towards the ala. The soft parts are retracted on either side so as to expose the nasal bone and the nasal process of the superior maxilla, a wedge-shaped portion of which can be divided by cutting-pliers and prised upwards, but left with their superior connections untouched, so that after the operation they can be replaced.

When the septum alone is involved in malignant disease, it is possible to deal with it by an operation, which consists in splitting the upper lip in the middle line, and carrying the incision round the ala nasi on each side so that the lower portion of the nose can be turned upwards after dividing the septum. A wedge-shaped portion is then removed from the front of the palate after detaching the muco-periosteum from its buccal aspect. An excellent approach is thus obtained into the nasal cavity, and the entire septum can in this way be removed without difficulty. The parts can be afterwards brought together quite naturally, and the deformity is very slight.*

(*b*) When the disease is located further back, originating rather in the naso-pharynx than in the nose itself, the *palatine route* may be used with advantage. Perhaps the best of the several suggested operations is that of *Nélaton*. This consists in a median section of the velum and of the mucous membrane covering the posterior half of the hard palate. A transverse incision is then made on either side of the anterior extremity of this, and two muco-periosteal flaps are reflected, exposing a quadrilateral area of bone which is removed by chisel and mallet. If need be, part of the vomer is also taken away, and thus the naso-pharynx is opened sufficiently to allow of the removal of the polypus or growth. The reflected segments of the palate are subsequently sutured together.

(*c*) Various methods of *osteoplastic section of the superior maxilla* have been practised, and Langenbeck's name has been associated with one or two different plans, which are, however, only suited to particular cases of disease, and at best give but poor access to the parts behind or above the superior maxilla, whilst they usually leave extremely ugly cicatrices. Perhaps the best plan to adopt is to detach the superior maxilla temporarily from its bed, turning it outwards together with the cutaneous and subcutaneous tissues overlying it, and then, after completing the operation, replacing the bone and suturing the soft parts into position. The results of such practice have been encouraging.

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* A patient on whom this operation was performed eight years ago for undoubted epithelioma of the septum reported himself at hospital whilst this edition was in the press; he was quite free from recurrence, and apart from a sunken bridge to his nose, there was no deformity.

Adenoids.—It has been already mentioned that the naso-pharynx is the seat of a large amount of lymphoid tissue, similar to that met with in the tonsil, which may either be distributed widely over the whole mucous membrane, or be gathered into a special mass on the roof, known as the pharyngeal or Luschka's tonsil. Adenoids consist in a hyperplasia of this tissue, exactly analogous to the chronic hypertrophic form of tonsillitis, with which, indeed, it is often associated. They usually occur in the form of broad, cushion-like masses springing mainly from the roof or posterior walls, or occasionally as pedunculated tumours hanging down into the posterior nares. The tumours are extremely soft and vascular, bleeding very readily. The surface is often plicated, and in the recesses or folds between the different portions of the mass bacteria lodge and give rise to various inflammatory troubles, both locally and in neighbouring lymphatic glands. Not uncommonly isolated masses similar in structure to the above are also to be seen on the posterior wall of the pharynx, and a certain amount of chronic rhinitis and laryngitis may be associated. The condition is rarely seen in others than children, and especially in those living in the smoky atmosphere of large towns. If untreated, they usually atrophy in time, but not before much harm may have been done to the individual.

FIG. 308. — ADENOID FACIES. (FROM A PHOTOGRAPH KINDLY LENT BY DR. ST. CLAIR THOMSON.)

This illustration shows well the sleepy look, the pinched nostrils, the open mouth and projecting upper central incisors, so characteristic of this condition.

The **Symptoms** are mainly due to obstruction to nasal respiration. The mouth is generally held half open, so as to allow the child to breathe through it, thereby exposing the upper central incisors (Fig. 308); for a similar cause he snores during sleep, and usually wakes with the mouth and tongue dry. The nostrils are drawn in, and the nose thin and pinched, the whole aspect being very characteristic; the children often look sleepy and half silly, and indeed may be very backward in their studies. Not uncommonly there is a certain amount of semi-purulent discharge from the nose, or it may be

hawked up from the pharynx, perhaps mixed with blood. Acute or chronic otitis media results from extension of the catarrhal condition to the mucous lining of the Eustachian tubes, and deafness may be thereby induced; both taste and smell are sometimes impaired. The palate becomes high and arched, owing to the defective intranasal air pressure, and as the patient grows up, the incisor teeth may project forwards, giving a curious rabbit-like expression to the face. The cervical glands are sympathetically enlarged, and often the seat of tuberculous disease. In bad cases which have been allowed to persist throughout adolescence the thorax becomes flattened owing to the inability of the child to take a really deep inspiration, the ribs are drawn in, and the spine is kyphotic (Fig. 309).

FIG. 309. LATERAL VIEW OF A CHILD WITH NEGLECTED ADENOIDS. (FROM A PHOTOGRAPH LENT BY DR. ST. CLAIR THOMSON.)

This is the same child whose face appears in Fig. 308. It will be seen that the chest is shallow and retracted, and the spine kyphotic. The arms are small, but the legs are well developed.

Physical Examination consists in posterior rhinoscopy, by means of which the growths can be seen, or in palpation of the posterior nares, a process more suitable to children, who rarely have sufficient control to permit of the former. On passing the finger behind the velum, the naso-pharynx is found to be occupied by a soft mass of tissue which readily bleeds, and more or less obstructs the openings of the posterior nares.

Treatment consists in the great majority of cases in removal of the adenoids by operation. In mild cases, however, much may be done by enforcing respiratory exercises with the mouth shut; and in young adults attention to the general health, combined with irrigation of the nose with salt and water, and perhaps the local application of a weak solution of nitrate of silver (5 grains to 1 ounce) to the naso-pharynx, may suffice to bring about improvement.

Operation.—Some diversity of opinion exists as to the character and extent of the operation; some authorities consider that all that is required is to scrape the growths away with the finger-nail, and undertake this proceeding either under nitrous oxide gas, or even without an anæsthetic. Such a measure is, to our minds, unsatisfactory, in that the adenoids cannot possibly be entirely removed, and recurrence may ensue. As a general rule, the child should be anæsthetized with chloroform, and the head may be allowed to hang

backwards over the end of the table. If enlarged tonsils co-exist, these should be dealt with in the first place. Gottstein's curette or some modification of it is then introduced behind the soft palate, the velum being drawn forwards by the left index finger. It is pressed upwards so that its free convex edge impinges on the upper part of the posterior border of the nasal septum. It is then swept backwards and downwards over the pharyngeal wall, so as to shave away the chief portion of the projecting mass of adenoids. Possibly the application of a second smaller curette may be required to deal with outlying lateral portions of the mass; and finally the adenoid tissue about the orifices of the Eustachian tubes and any remaining tags are removed by the use of Löwenberg's forceps or the finger-nail. Of course, there is considerable bleeding, but this quickly stops of itself; as soon as the operation is over, the child should be turned over and held face downwards, so as to allow the blood to run out of the mouth and nose, whilst the face and forehead are sponged with ice-cold water to check the hæmorrhage. The patient is kept indoors for a few days, and only fluid food allowed. No local after-treatment is required as a rule, but the throat may be gargled or the nose washed out with weak salt and water. Nose-breathing exercises should be subsequently instituted.

Epistaxis, or bleeding from the nose, may arise from a variety of causes, including traumatism, directed either to the mucous membranes or the bones, or from the presence of ulceration or tumours. Some of these local causes are very evident, if only they are carefully looked for with a rhinoscope and frontal mirror. One of the commonest lesions is a small abrasion or ulcer of the septum, due to detaching by the finger a scab or dried crust of mucus which causes irritation within the nostril; each time the nose is 'picked' in this way, bleeding recurs. Another frequent source of epistaxis is the rupture of a varicose vein in the mucous membrane of the septum; varix occurs not unusually in plethoric individuals, and sneezing or blowing the nose violently may lead to an attack. Foreign bodies may also cause hæmorrhage, as also ulceration of an angioma on the septum. It frequently occurs in young people about puberty in consequence of local disturbance in the vascular arrangement of the parts; again, cerebral congestion may induce it, owing to the communication by means of emissary veins between the interior of the skull and the venous plexuses in the nose; excessive changes in the atmospheric pressure, as in mountaineering, may lead to epistaxis, whilst in abnormal states of the blood it may be associated with hæmorrhage elsewhere, as in hæmophilia, purpura, and scurvy. One or both nostrils may be the seat of the bleeding, and it may be so excessive as even to threaten life.

Treatment.—It must not be forgotten that, in the majority of cases, there is some local cause of epistaxis which can be found and treated directly—a fact which once more emphasizes the necessity for gaining a mastery over the use of the rhinoscope. The bleeding is generally unilateral, and in nine out of ten cases the source is within easy

reach of the anterior nares, and hence in many instances all that is required is to grasp the nostrils firmly, and thus allow the blood to collect within, and give it an opportunity of clotting. At the same time, the patient should sit up, and cold be applied to the root of the nose, or to the nape of the neck. If on examination the bleeding-point is detected, whether it be a varicose vein or an ulcerated surface, the hæmorrhage can almost at once be stayed by applying a pointed galvano-cautery, or by sealing the spot with a swab soaked in a solution of chromic acid. Failing these measures, the nostrils may need to be plugged, but such a proceeding ought to be seldom resorted to; it is practically a confession of want of skill in the use of the rhinoscope. It may suffice merely to stuff the anterior nares with long strips of boric lint, but, as a rule, the posterior nares also require plugging. For this purpose Bellocq's sound (Fig. 310) is usually employed in order to pass a thread round the base of the palate, and out of both nose and mouth; but where it is not obtainable, a suitably curved pair of laryngeal forceps or a catheter may be used instead. To the lower end of this thread a pledget of lint about

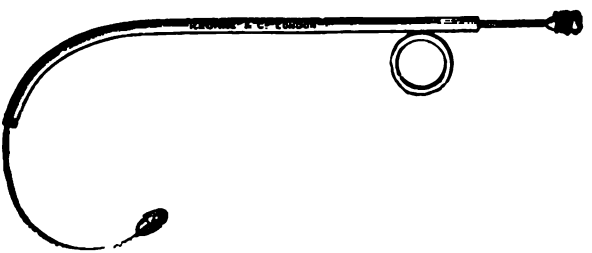

FIG. 310. - BELLOCQ'S SOUND.

1½ inches by 1 inch in size is attached, and this, guided by the finger round the soft palate, is drawn tightly forwards into the posterior nares. It is a good plan to have two threads coming forwards out of the nose, and these may be tied firmly around a pad of lint placed over the side of the nostril, thereby occluding the anterior nares and completely blocking the nasal cavity, back and front. The loose end of the thread emerging from the mouth is fixed to the cheek by a strip of adhesive plaster. The plug is retained for twelve hours, and then removed, and the nasal fossæ irrigated with a weak warm alkaline antiseptic lotion in order to prevent sepsis.

Another method of arresting epistaxis is by Cooper Rose's inflating plug; it consists of a piece of gum catheter, surrounded by a thin indiarubber bag, which can be inflated through the hollow stem. It is oiled and passed well into the nose from the front; the indiarubber bag is then inflated to the required extent, the air being retained by a stop-cock. This generally acts most efficiently, and can be introduced and removed with scarcely any pain to the patient.

CHAPTER XXIX.

AFFECTIONS OF THE MOUTH, THROAT, AND ŒSOPHAGUS.

Stomatitis, or inflammation of the mucous membrane of the mouth, is by no means uncommon, especially in children.

1. **Simple Catarrhal Stomatitis** results from mechanical irritants, such as roughened teeth, from irritating chemicals, or from that septic form of inflammation which is so liable to follow operations involving the mouth. It may also arise in the course of fevers, and in conditions of debility such as follow measles and other exanthemata in children; or be associated with disturbances in the alimentary canal, as by improper feeding, dyspepsia, etc. The mucous membrane becomes hyperæmic and swollen, usually in small localized patches, which may gradually spread and become confluent, involving nearly the whole of the oral cavity. The exudation of mucus is increased, and becomes viscid and turbid, whilst the epithelium, at first white and sodden, is after a while rubbed off, leaving superficial erosions or distinct ulcers, which are very painful. The *treatment* consists in the removal of all sources of irritation, and the administration of drugs to correct intestinal derangements. Chlorate of potash, possibly combined with dilute hydrochloric acid, is very useful, both locally and internally. In the more severe cases antiseptic mouth-washes should be employed, such as the liquor sodæ chlorinatæ (1 ounce to 1 pint of water), sanitas (1 in 10), boro-glyceride (1 in 20), etc.

2. **Aphthous Stomatitis** occurs in badly-fed children, in the form of small whitish spots on a hyperæmic base, which run together, and produce ulceration. Attention must be directed to the general condition, and a little borax and honey or a solution of boro-glyceride (1 in 20) applied locally.

3. **Thrush** is a very similar condition, but due to the presence of a parasitic fungus, the *Oidium albicans*. It occurs in patches somewhat resembling curdled milk in appearance, and requires the same treatment. In both these types there is often considerable enlargement of the lymphatic glands, which, however, frequently subside without suppuration on removal of the cause.

4. **Gangrenous Stomatitis** is much the same in origin as the preceding, but more acute in its course. It occurs in debilitated children

or elderly people, the subjects of albuminuria or diabetes, and is usually due to foul and dirty teeth. The gums and adjacent tissues become gangrenous, and severe toxic symptoms result. Active treatment by scraping and the use of antiseptics, such as peroxide of hydrogen, is urgently necessary.

In children this condition is known as *Cancrum oris* (p. 109).

5. **Mercurial Stomatitis** may arise during the administration of a course of mercury, or occasionally from a single dose in persons who are sensitive to its action. It is increased in severity if the mouth and teeth are dirty, or if the patient smokes to excess. The gums are swollen and tender, bleed on pressure, and are very painful, especially when biting, or drinking hot fluids. The teeth may become loose and fall out, whilst the alveolar borders may be laid bare and necrose. The tongue is sometimes swollen and inflamed; salivation is a marked symptom, and the breath becomes very offensive. *Treatment.*—Either leave off the mercury, or at any rate reduce the dose considerably, and administer saline purgatives. Chlorate of potash, combined with alum, dilute hydrochloric acid, or tincture of myrrh, may be useful locally.

6. For **Syphilitic Stomatitis**, see p. 143.

The buccal mucous membrane is also involved in the course of other diseases, *e.g.*, diphtheria, scarlet fever, and erysipelas, but special descriptions are not needed here.

Affections of the Tongue.

Congenital Abnormalities.—(*a*) The tongue has been entirely absent. (*b*) One half of the tongue is defective in size (*hemiatrophy*). (*c*) *Tongue-tie* is said to be present when the frænum is shorter than usual, causing the tip to be depressed and fixed in the floor of the mouth so that it cannot be protruded. Sucking becomes difficult in such a condition, and when it is allowed to persist, there is often a lisp in the speech. Treatment is only needed in the severer forms, and consists in raising the tongue with the index and middle fingers placed one on either side, and snipping the frænum, thus put on the stretch, across its centre with a pair of blunt-pointed scissors directed downwards. (*d*) The tongue may be adherent to the floor of the mouth, being *bound down* by folds of mucous membrane (*ankyloglossia*). This may also exist as an acquired condition due to cicatricial contraction after ulceration. In congenital cases the adhesions are but slight, and the organ can be readily freed; in the acquired condition this cannot always be accomplished. (*e*) The frænum and tongue are occasionally too long, allowing of increased mobility, and even fatal results have occurred from the organ rolling backwards and impeding respiration. (*f*) The tongue may be *cleft*, presenting a bifid appearance; this may be complete or partial, and is usually associated with a congenital fissure through the lower lip and mandible. (*g*) *Macroglossia* (or large tongue), although sometimes acquired, is usually a congenital deformity. The organ is enlarged

in all directions, and protrudes from the mouth, so that the teeth indent it, and cause ulceration and considerable interference with the venous return. It thus becomes purplish and dry from exposure, the mucous membrane looking almost like skin, although saliva dribbles freely from beneath it. In old-standing cases the teeth are displaced outwards and the jaws deformed, so that, even if the tongue is reduced to its normal size by treatment, it may be impossible to close the mouth. Pathologically, it is due to diffuse overgrowth of the connective tissue, secondary to lymphatic obstruction and dilatation. Recurrent attacks of lymphangitis add to the trouble, the tongue gradually increasing in size, and the disease has been known to terminate in the development of a lympho-sarcoma. The *treatment* consists in excision of a V-shaped portion, suturing the raw surfaces subsequently with catgut.

Wounds of the tongue are usually caused by the teeth, especially during an epileptic seizure, or in children as a result of falls with the tongue out. There is often brisk hæmorrhage for a few moments, which soon ceases, though blood may be extravasated into its substance, and cause considerable swelling. In simple cases the wound should be examined and purified, and the mouth constantly cleansed with mild antiseptic lotions; a few points of suture may also be inserted if necessary, but the wound must not be entirely closed, or tension from sepsis will result. When smart arterial bleeding is present, the mouth must be opened, the tongue pulled forwards, and the wounded vessel sought for and tied. Failing this, the lingual artery may be tied in the neck, or even the external carotid.

Acute Superficial Glossitis occurs as part of a general stomatitis, and needs no special notice.

Acute Parenchymatous Glossitis, or acute inflammation of the tongue, may arise from penetrating and, of necessity, septic wounds, or from the bites or stings of insects, or may be associated with acute stomatitis in the course of fevers, but is most commonly due to the injudicious administration of mercury. The condition may be limited to one half of the organ, but when arising from general causes is bilateral. The tongue becomes painful, swells up rapidly so as to fill the mouth, and even protrudes beyond the teeth, the pressure of which leads to superficial ulceration. The salivary glands are enlarged and painful, and salivation is a marked feature in the case. Speech, swallowing, and even respiration are much interfered with, and there may be considerable febrile disturbance. The case, if treated with care, usually ends in resolution; but diffuse or localized suppuration may ensue, as well as the most urgent dyspnœa, arising either from œdema glottidis or from the pressure of the enlarged organ. *Treatment* consists in stopping the mercury, or removing any evident cause, and in the administration of saline purgatives with chlorate of potash. Leeches may be applied beneath the angles of the jaw, but in bad cases a free incision into the dorsum should be made on either side of the median line to give exit to the effused fluids and blood. The most rapid relief to the symptoms is thereby obtained.

although the organ may remain enlarged for some time. If asphyxia is threatening, high tracheotomy or laryngotomy is required.

Abscess of the tongue may result from the acute process described above, but is more usually of a chronic nature, and situated at the anterior part of the organ. It is generally due to the admission of micro-organisms through some superficial lesion which has quickly healed. It presents as a tense swelling, fluctuation in which may be masked by the amount of inflammatory thickening which surrounds it. A free incision both settles the diagnosis and cures the case.

Chronic Superficial Glossitis is an interesting and important disease, which may be associated with a similar condition of the mucous membrane lining the interior of the cheeks and lips. It is most commonly due to syphilis, occurring as a tertiary phenomenon, but may arise from excessive smoking, ragged and rough teeth, or spirit-drinking, chronic dyspepsia, perhaps of a gouty nature, being also present in many cases. It is very liable to be followed by epithelioma, Barker stating that out of 110 cases he carefully investigated cancer occurred in 43.

For purposes of description it is useful to divide the disease into the following five stages, although it must be clearly understood that they are artificial, and several of them may be present in different parts of the same tongue. (i.) The papillæ become enlarged and swollen, leading to the appearance of red hyperæmic patches, which cannot be recognised for certain unless the tongue is thoroughly dried with a handkerchief, towel, or piece of clean blotting-paper, which must not be carelessly dabbed over the organ, but should be firmly pressed down upon it so as to absorb all the moisture. (ii.) Overgrowth of epithelium follows, and as it increases in thickness, it becomes opaque and horny, so that the red patches are replaced by white ones, leading to the appearance which has been designated *Leucoplakia*. Sometimes the papillæ become much enlarged, and stand out definitely and separately from the organ; or the whole surface may be covered with dense white patches. To this condition the term *Ichthyosis* has been applied. (iii.) Later on, the excess of epithelium is shed, leaving red smooth patches in which the papillæ are atrophied, or have entirely disappeared. If this occurs over the greater part of the organ, the *glazed red tongue* so characteristic of tertiary syphilis is produced. If, however, this process only occurs in smaller areas intermixed with portions covered with white epithelium, a patchy appearance of the tongue results, wrongly termed *Psoriasis linguæ*. (iv.) At varying periods of the disease, sometimes earlier, sometimes later, the organ becomes ulcerated, *cracked*, or *fissured* in a somewhat characteristic manner. A median fissure is usually seen running down the middle, and from this furrows extend transversely, dividing the surface into rectangular compartments. These fissures are not always due to the cicatrization of cracks, as when opened out healthy papillæ are seen at the base, and no sign of superficial scarring. They are, then, evidently the result of the contraction of deep sclerosed tissue in the substance of

the organ. Superficial ulceration often occurs, apart from these fissures, being probably due to some local irritation, or to smoking; the atrophic condition of the mucous membrane explains the great liability to this occurrence. (v.) Still later, epithelioma may develop, and usually in connection with one of the cracks, or of the cicatrices arising therefrom. It is often somewhat slow in its progress, owing to the amount of sclerosis induced by the preceding inflammation. The typical *smoker's patch* is a red irritable area on the front of the tongue, from which papillæ are often absent, and perhaps covered with a yellowish-white crust. Sometimes the epithelium is heaped up here into a well-marked leucoplakic spot.

All these stages of the disease are accompanied with much discomfort, the tongue being sometimes so tender that the patient cannot drink hot fluids or take condiments or stimulants without pain. The speech, too, is interfered with, becoming thick and indistinct. The course of the case varies considerably, and if cancer does not follow, the affection usually settles down after a time, and causes but little discomfort, so long as the patient conforms to the restrictions as to diet, etc., which are essential.

The *treatment* of the case is usually a matter of some difficulty. All sources of irritation are excluded from the mouth as a first precaution. Thus, smoking or chewing tobacco must be rigidly prohibited. Spirit-drinking and all acid wines which cause pain should be forbidden, dilute whisky and water being perhaps the best stimulant. The teeth must be well brushed night and morning, and all stumps and rough excrescences removed. Condiments, such as mustard, spices, curry, and cheese, are excluded from the dietary, and only simple unirritating ingesta allowed. The mouth is washed out frequently with an alkaline lotion, *e.g.*, bicarbonate of soda (20 grains to 1 ounce), or borax (10 grains to 1 ounce), especially after meals, so as to exclude all risk of acid fermentation in the débris of food. Cracks and sores are treated by painting the surface with a solution of chromic acid (grs. v. ad ℥ i.) or of perchloride of mercury (grs. ii. ad ℥ i.). Solid nitrate of silver should be avoided, as Mr. Butlin points out its use is likely to predispose to epithelioma.

General antisyphilitic remedies are employed where necessary; the digestion is attended to, and if the new formation of epithelium is excessive, arsenic may be administered.

On the appearance of definite epithelioma suitable operative measures must be instituted; but it is perfectly justifiable to remove by operation irritable and infiltrated fissures and cracks, even before true cancer has appeared. Any wart-like projections should also be excised early.

Ulceration of the tongue arises from a variety of causes, and occurs in many different forms. Thus, *irritable* ulcers are due to rough and carious teeth. *Dyspeptic* ulcers are associated with gastric disturbances; they are usually located on the middle of the dorsum, and are often very painful. It is sufficient to touch them with lunar caustic after dealing with the cause. *Tuberculous* ulcers are

common, and are always secondary to pulmonary or laryngeal phthisis, the organ being infected by the sputum. They commence in the form of a submucous abcess, which bursts and leaves a small painful sore, rarely situated on the posterior part of the organ, but chiefly at the sides or on the dorsum near the tip. Secondary abscesses form around and coalesce with the original ulcer. *Treatment* is chiefly needed on account of the pain and discomfort caused by them; it consists in cocainizing and scraping the sores, touching the base with pure carbolic acid, and dressing with iodoform. Applications of cocaine may also be made before meals, as a palliative measure where radical treatment is not undertaken on account of the extent of the pulmonary mischief. *Lupus* also attacks the tongue, but is very uncommon, and almost invariably secondary to a similar affection of the skin of the face. In a case under our care it appeared in the form of an irregular granulating surface surrounded by nodulated cicatricial tissue of an exceedingly dense character. The progress was very slow, owing to the amount of sclerosis present. Treatment consists in the application of the X rays or of radium; but in some cases it may be advisable to undertake a preliminary course of treatment by scraping and cauterization. *Syphilitic* and *cancerous* ulcerations are described below.

Syphilitic Disease of the tongue occurs in a variety of different forms. A *primary* sore presents a characteristic indolent and inactive surface, usually near the tip, with subjacent infiltration, and much chronic enlargement of the submental lymphatic glands, which, however, do not generally suppurate. In the *secondary* stage mucous tubercles, fissures, and ulcers form, and usually on the sides or near the tip. Occasionally one meets with a broad wart-like condyloma on the dorsum, which may be associated with longitudinal fissures; it is sometimes termed 'Hutchinson's wart.' In the *tertiary* period chronic superficial glossitis may develop, as also diffuse infiltration of the organ, or gummata.

Gumma of the tongue is not uncommon, occurring usually in patients under forty years of age, as a late tertiary phenomenon. It starts as a localized submucous or intramuscular infiltration near the median line, and generally towards the middle or posterior part. The swelling is at first hard and firm, but later on becomes soft and fluctuating, and in time the overlying mucous membrane, which was unaffected, yields, and gives exit to the characteristic contents. The ulcer thus produced is oval or round in shape, and deeply excavated, the base being constituted by a slough, looking like 'wet wash-leather.' There is but little induration either of the base or edges, and one of the most characteristic features is the fact that neither the floor of the mouth nor the base of the tongue is involved, so that the organ can be freely protruded, whilst deglutition and articulation are scarcely interfered with. The patient complains of little pain, and the submaxillary glands are only affected either as part of a general enlargement throughout the body, or from the local irritation. The progress is slow, and the effect of antisyphilitic treatment very

decided, the gumma absorbing, or the ulcer, if present, healing readily, but leaving a localized area of sclerosis or a deep cicatrix, from which malignant disease may subsequently originate. In some cases a diffuse infiltration of the organ occurs, leading to a generalized sclerosis rather than to a localized gumma. The *treatment* consists in the administration of iodide of potassium with or without mercury, whilst the mouth is kept clean with a simple mouth-wash.

Innocent Tumours are not frequent in the tongue, papilloma, cysts, lipoma, and nævi being the chief varieties, and requiring no special treatment.

Dermoid Cysts also form within or under the tongue, originating usually in connection with the thyro-glossal duct (p. 893).

Cancer of the Tongue occurs in the form of squamous epithelioma, and is both a frequent and a very fatal variety of this disease. It is usually met with in men, and may arise as a result of the irritation caused by excessive smoking, especially of cigars, cigarettes, or foul pipes.

Its mode of onset varies somewhat according to the situation: (*a*) It arises most commonly as an ulcer at the margin of the organ, towards the junction of the middle and posterior thirds, and is then probably due to the irritation caused by ragged and irregular bicuspid or molar teeth; (*b*) it may start in a crack, fissure, or cicatrix on the dorsum, as a result of chronic superficial glossitis, or of a preceding gumma; (*c*) it may commence as a wart-like growth, the base of which becomes infiltrated, the tumour invading the muscular substance, and spreading to the root of the tongue; (*d*) it may originate as a submucous infiltration, starting as an ingrowth from the mucous membrane, without much external manifestation of its presence; (*e*) it may first be noticed as an irregular ulcer in the floor of the mouth; or (*f*) it may spread into the tongue from surrounding parts, such as the tonsil or larynx.

In whatever way it starts, the same features are soon manifested, viz., a new growth is noticed, hard in consistence, indefinite in its extent, which may or may not be painful from the first, and which ulcerates superficially, exposing a more or less crateriform cavity, with a gray, sloughy, foul surface, readily bleeding when touched, and discharging a foul secretion, which causes extreme fœtor of the breath. The ulcer is surrounded by an indurated mass, which gradually shelves off into the neighbouring healthy structures, or may be abruptly limited. Profuse salivation is produced by the irritation of the branches of the third division of the trigeminal, and all the movements of the tongue are painful and limited on account of the infiltration of the base, so that both swallowing and speech are difficult, the patient allowing the saliva to dribble out of his mouth. The pain is often very excessive, and usually extends along many of the branches of the fifth nerve, especially to the ear, so that sleep becomes impossible, and the patient's condition steadily and rapidly deteriorates. The glands under the chin and at the angle of the jaw early become involved in the disease, which ultimately attacks

the deep glands in the neck. These secondary growths are very frequently cystic in character, from the degeneration of the masses of epithelium formed within them; after a time they approach the surface and burst, leaving ragged malignant ulcers in the neck. The lower jaw, moreover, is often invaded in the later stages of the disease.

The occurrence of the typical cachexia is determined not only by the pain and consequent sleeplessness, but also by the inability to take sufficient nourishment, the absorption of products of putrefaction swallowed with the saliva, the excessive salivation, the occasional hæmorrhages, and the extent of the secondary growths. The patient rarely lasts, apart from treatment, for more than twelve months after the disease has been first noticed.

Diagnosis.—When a case is met with where the ulcer is situated at the side or base of the tongue in a patient over forty-five years of age, with the typical enlargement of the glands, profuse salivation, and impaired movements, there can be little doubt as to the diagnosis. But when it is seen in the early stage, as an infiltration of a syphilitic fissure or cicatrix, or as a small wart, it may be difficult to determine whether or not malignant disease is present. The early enlargement of the glands, the amount and character of pain, the fixity of the organ, and the infiltration of the base of the ulcer, are important guiding marks; but in doubtful cases a small portion of the growth should be excised under cocaine, and subjected to careful microscopic examination, and thus its nature ascertained. Moreover, the administration of steadily increasing doses of iodide of potassium will generally bring about rapid improvement in a syphilitic case, but will do no good to an epithelioma, except perhaps temporarily when the two diseases co-exist.

Treatment.—The only hope of curing the patient lies in thorough and early removal of the growth, which, it must be remembered, has probably extended much further than one expects. Hence, no half-measures should be adopted, but complete operations, including also the lymphatic area, are desirable. For practical purposes, the cases may be divided into two groups—those in which the disease is limited to one portion of the tongue, and the muscular tissue is not extensively invaded; and those in which glands or other structures are also obviously involved, or the tongue itself is widely infiltrated. In the first class of cases a simple intrabuccal operation will often suffice, combined with separate removal of the glands; in the second, more extensive procedures are required.

In all cases great care must be taken in the preparation of the patient so as to minimize the risk of septic contamination. The mouth is often very foul, and must be dealt with by removing all septic roots of teeth, cleansing thoroughly the teeth that remain, and using frequent antiseptic mouth-washes. Antistreptococcic serum (of the polyvalent type) may also be utilized as a preliminary measure in order to diminish the likelihood of septic troubles; three or four injections of 10 c.c. each are made on the day preceding the

operation, and perhaps one or two afterwards. The results obtaine in this way have been satisfactory.

The **Intrabuccal Method** now adopted for *partial removal* of th organ is that known as *Whitehead's Operation*. The lingual arter should always be previously secured in the neck (p. 330), thus givin the surgeon an opportunity of clearing the submaxillary region; th should include the removal of the submaxillary and submenta lymphatic glands, as well as those lying over the external caroti artery, and it is always wise to include the submaxillary salivary glan No half-measures are allowable, but a wide and sweeping dissectio is required. The mouth is then well opened with an efficient gag, an chloroform administered by means of Junker's apparatus. A goo assistant is necessary in order to prevent blood entering the laryn small swabs or pieces of sponge held in smooth-nosed, long-handle forceps or suitable sponge-holders being used to clear the pharyn A coarse silk thread is passed through each half of the tongue t draw it forwards and steady it. The tongue, being drawn out of th mouth by these loops of silk, is carefully divided by blunt-pointe straight scissors down the middle line into two segments, which ar readily separated from one another by the finger, the scissors merel dividing the mucous membrane. The base of the organ is freed b cutting through the line of attachment of the mucous membrane t the alveolus, and then along the middle line of the floor of the mout from the tip of the tongue, so that the sublingual salivary gland can b also taken away—a most necessary step. The mucous lining of th dorsum is now divided transversely behind the growth, and th muscular structure of the organ slowly snipped through with scissor during this process, by the aid of the finger or a director, t vessels and nerves can be seen and recognised before divisio Removal of the diseased half with the sublingual gland is thus eas accomplished by making the incisions meet, and dividing the int vening tissues. Bleeding-points are picked up and secured as t appear.

If the *tip* is alone involved, it can be removed by a V-shaped incis made after steadying the tongue with a deep suture. The small ra artery will spurt on each side, but is easily secured, and the gap cl by catgut sutures.

If the *whole tongue* is to be excised, or even when one side alone r removal as far back as the epiglottis or hyoid bone, a more exte operation is necessary; and up to a recent date the *extrabuccal m* recommended by *Kocher* was chiefly utilized. A preliminary tr tomy was usually associated with it. An incision (Fig. 300, C) is commencing close to the lobule of the ear, running down alo anterior border of the sterno-mastoid to the great cornu of the bone, and thence forwards nearly to the middle line, and upw the symphysis. This flap of skin and subcutaneous tissue is di up, and stitched to the cheek out of harm's way. All the lyr glands in the region the submental, submaxillary, and thos over the carotid—are now removed, as well as the subm salivary gland, the lingual and facial arteries being tied clo

carotid. Any diseased portion of the jaw is isolated by saw-cuts in front and behind, and removed. Where only half the tongue is to be removed, it is now split down the middle line with scissors, and the mucous membrane in the floor and side of the mouth divided so as to leave that side of the tongue attached merely by the muscular structures. If the whole organ is to be removed, it is unnecessary to divide it in the middle line. By detaching the mylo-hyoid from the bone a communication is made between the outside wound and the mouth, and the tongue is then drawn through this lateral opening, and can be removed as far back as the epiglottis behind and the hyoid bone below, the whole floor of the mouth being effectually dealt with in this way. The external incision is closed by a continuous suture a large drain-tube being inserted at the lowest point for a few days

It is obvious that such an operation is not devoid of serious risks from sepsis, since a deep and extensive dissection of the neck after exposing freely the main vessels is brought into direct communication with the cavity of the mouth, which is often exceedingly foul. The death-rate has not been insignificant, and hence Kocher himself has returned to the method formerly recommended by *Syme*.* An incision is made in the middle line dividing the lower lip, extending downwards to the hyoid bone. The mandible is sawn through in the middle, and the two halves separated widely. As much of the tongue as is considered necessary can be easily removed by the scissors. The mucous membrane is divided close to the alveolus laterally, the anterior pillars of the fauces are snipped across posteriorly, and the floor of the mouth is dissected up. The lingual vessels can usually be secured before division. After securing hæmostasis, a silk thread or silver wire is passed through the stump of the tongue and epiglottis in order to control it and prevent interference with respiration; the halves of the jaw are wired together; and the superficial wound closed.

In this procedure preliminary tracheotomy is not required as a rule, and the glands are dealt with subsequently as soon as the mouth wound has begun to heal, *i.e.*, in a week or ten days' time.

The **After-Treatment** is much the same in all cases. The raw surface may be painted with Whitehead's varnish (which consists of Friar's balsam, but with the rectified spirit replaced by a saturated solution of iodoform in ether); but the all-essential thing is to keep the cavity well washed out with antiseptic lotions, such as weak solutions of boric acid, boroglyceride (1 in 20), sanitas, or lysoform. The patient must be closely watched for the first forty-eight hours, to see that his respiration is not obstructed by the stump of the tongue falling backwards: but at the end of that time this danger will be at an end, and the silk or silver wire may be removed. The patient is fed *per rectum* for twenty-four hours, but afterwards a tube attached to the spout of a feeder is introduced into the pharynx or œsophagus. In the simpler cases he is able to swallow freely and

* 'Kocher's Textbook of Operative Surgery,' p. 109. Translated from the fourth German edition by Harold J. Stiles, M.B., F.R.C.S. London: Adam and Charles Black, 1903.

will expand and absolutely shut off the lower respirat
the mouth) is inserted, or a Trendelenburg's air-tampon;
tube may be employed if the pharynx is well packed
so as to prevent blood trickling downwards; the anæst
be administered through the tube. The advantages
of treatment are threefold: (*a*) The patient can be kept
of complete anæsthesia without hindrance to the surge
operation is more quickly finished, the shock is less, an
of the disease can be more thoroughly accomplished;
runs no danger of asphyxia during the operation by b
into the lungs, or by fragments of tissue or sponge g
the mouth and being inhaled, whilst later on falling ba
of the tongue does no harm; and (*c*) the chances of sep
are reduced to a minimum. Of course, opening the
entirely devoid of danger, and therefore this plan
adopted unnecessarily.

The removal of a part, or even the whole, of the tong
a mutilation physiologically as one might expect at firs
is interfered with for a time, but the power is soon
even articulation may be in great measure restored.

Affections of the Floor of the Mouth.

Sublingual Abscess, when acute, is due to infectio
mucous tissue, as by puncture with a fishbone, or sta
of the sublingual or in a submucous gland. The inflan
follows results in the formation of a puffy swellin
tongue, which, if not opened early, may lead to an ex
wards of the mischief into the submental region. The t
swollen and turgid from pressure upon the veins, whi
laryngitis may also be induced. Considerable constitu

tissues, progressing slowly, and not very tender. As it comes to the surface, the skin becomes red and dusky, and sooner or later a series of little pustules appear one after another with a typical yellowish apex. These burst and discharge a glutinous fluid containing the fungus, and if kept aseptic and allowed to heal, are followed by depressed and puckered cicatrices. The administration of gradually increasing doses of iodide of potassium usually suffices to bring about a cure.

Cystic Swellings are not uncommon about the floor of the mouth, and amongst them the following may be described:

(*a*) *Mucous Cysts* result from the distension of mucous glands; they form small translucent swellings, elastic and fluctuating. All that is needed is to open them, and remove the anterior wall.

(*b*) *Ranula* is a very similar condition, but larger and unilateral, containing a glairy mucoid fluid, and sometimes due to obstruction and distension of one of the sublingual ducts (or ducts of Rivini). A similar condition has been caused in rare cases by a blocking of Wharton's duct, but this has generally been found to run along the outer surface of the cyst. The tumour may be as large as a walnut or pigeon's egg. The *Treatment* consists in removing a good-sized piece of the wall so that the cavity may be obliterated by a process of granulation, or if that should fail, the whole cavity must be dissected out.

(*c*) *Dermoid Cysts* are frequently met with in the floor of the mouth, occupying the middle line, and also projecting into the neck beneath the chin. They are due to non-obliteration of the upper end of the thyro-glossal canal (p. 893). The contents are of the usual sebaceous type. Such tumours should never be dealt with from the mouth, as they extend deeply, and need to be carefully dissected out. A free opening must be made in the middle line under the chin, and, if feasible, the whole cyst removed unopened. If it gives way, the entire wall must be dealt with, or recurrence will certainly ensue.

Affections of the Salivary Glands.

Inflammation of the Parotid Gland is met with in several different forms.

1. **Epidemic Parotitis (Mumps)** is an acute specific disease usually seen in children, highly infectious in character, and generally epidemic. The period of incubation is about three weeks, and the attack itself consists in a slight febrile disturbance, associated with swelling of one or both parotid glands: one gland is attacked first, becoming enlarged and tender, whilst the other side is similarly affected in a day or two. Mastication becomes difficult, owing to the tension of the parts. The swelling, which lasts for about a week and then gradually subsides, extends below and in front of the ear, and the socia parotidis can be distinctly felt lying over the masseter; the submaxillary, sublingual, and neighbouring lymphatic glands are sometimes, but not frequently, enlarged. Suppuration is rare, but

in adults metastatic inflammation of the testes, mammæ, or ovaries is not uncommon. This complication is generally unilateral, and thus, although atrophy of the testis commonly follows orchitis, sterility is not produced. *Treatment.*—Keep the patient warm and quiet, and administer salines. In the later stages friction with stimulating liniments will hasten resolution. After the acute attack, the gland may remain enlarged for some time.

2. A **Simple Parotitis** occasionally results from exposure to cold or from injury, whilst the presence of a calculus in the duct leads to a chronic sclerosing inflammation. The symptoms consist of pain and swelling, together with a certain amount of constitutional disturbance. An extremely interesting phenomenon is the parotitis which follows injuries or diseases of the abdominal or pelvic viscera. This condition is not very unusual, as is evident by the fact that Stephen Paget has been able to collect 101 such cases. It was formerly attributed to pyæmia, but is now considered to be due to infection of a mild type from the mouth, owing to a septic state of the teeth induced by prolonged rectal feeding. In confirmation of this view is the fact that it has been seen in not a few cases of gastric ulcer, where the patient had been fed *per rectum* for some time. *Treatment* in these simple cases consists in the application of fomentations, perhaps medicated with belladonna.

3. **Suppurative Parotitis** is a much more serious condition. It may extend from the mouth along Stenson's duct, or supervene in the course of pyæmia, or as a sequela of some of the exanthemata, *e.g.*, scarlet or typhoid fevers. If the inflammation spreads up from the mouth, suppuration occurs primarily within the tubules; under other circumstances, pus forms in the interstitial tissues. The gland becomes much enlarged, with congestion and œdema of the overlying skin, and, owing to the tension of the fascia, exceedingly painful. For the same reason, pus cannot readily find its way to the surface, and hence is likely to burrow in various directions, *e.g.*, amongst the muscles of the neck, or even upwards and inwards towards the base of the skull, or to the cavity of the mouth, finding its way over the border of the superior constrictor (the so-called 'sinus of Morgagni'). The constitutional symptoms from toxic absorption are usually very severe. Owing to the fact that large veins and arteries pass through the parotid gland, pyæmic symptoms are not unlikely to supervene, and the prognosis is therefore somewhat serious.

Diagnosis.—Inflammation of the lymphatic glands lying on the outer surface of the parotid closely simulates the above affections, but is distinguished from them by the fact that they are more superficial, and that the socia parotidis is not enlarged.

Treatment.—In the early stages fomentations are employed, but as soon as there is any indication that suppuration has occurred, a free incision must be made, and the pus let out. Every precaution should be taken to prevent mischief to the facial nerve, and Hilton's method of operating may be advantageously employed; but in the more severe cases where the patient's life is threatened and the pus

is burrowing in all directions, the knife must be freely used regardless of anatomical considerations.

Inflammation of the **submaxillary** and **sublingual** glands may arise in an exactly similar way, but no special description is called for. Occasionally, however, the process extends beyond the submaxillary gland to the neighbouring tissues, giving rise to what has already been described as submaxillary cellulitis, or Ludwig's angina (p. 75).

Obstruction to the Flow of Saliva results from various causes, such as cicatricial contraction in the neighbourhood of the entrance of the ducts into the mouth, or from the presence of a *salivary calculus*, consisting of phosphate and carbonate of lime, and usually fusiform in shape.

The chief **Symptom** of such obstruction is a painful enlargement of the gland during and after meals, which slowly passes away as the saliva finds its way past the block; if it persists for long, the gland becomes chronically enlarged, and its interstitial tissue increased in bulk, whilst a certain amount of peri-adenitis also follows. When a calculus is present, there is usually a considerable discharge of offensive muco-pus into the mouth. Where the obstruction is complete, a cyst may form, and if this is opened, or finds its way to the exterior and bursts, a salivary fistula results. The formation of salivary calculi is not very common in connection with the parotid gland, owing to the fact that the saliva excreted is limpid in character, whereas that arising from the submaxillary and sublingual glands is thick and mucoid.

FIG 311. PAROTID TUMOUR. (FERGUSSON.)

Treatment.—In cases of simple obstruction, an attempt must be made to restore the natural exit, or to make an artificial one. If a calculus is present, it can usually be seen or felt at intervals projecting from the entrance of the duct; in such a case the duct must be incised, and the stone removed. Where, however, it is located in the substance of the submaxillary, total removal of the gland may be necessary.

Tumours of the Parotid Gland are of considerable interest, and may be simple or malignant.

(*a*) The **Simple** parotid tumour is usually an *endothelioma*, in which, however, fibrous and adenoid tissue may occur. It usually commences near the surface in the endothelium lining the bloodvessels and lymph spaces, and, owing to a colloid or mucoid degeneration of the interstitial tissue, may simulate a chondroma or myxoma. The tumour feels hard, firm, and nodular, but areas of softening may be interspersed amongst the harder portions. The mass is situated

between the jaw and the sterno-mastoid, accessory processes also extending over the masseter in the region of the socia, and later on burrowing deeply between the mastoid bone and the styloid process, and beneath the ramus of the jaw (Fig. 311). In the early stages the tumour is freely moveable on the deeper parts, as is also the skin over it, but subsequently the mass becomes fixed and adherent. The growth is usually slow, and at first quite painless, and there is no tendency to invade lymphatic glands or produce cachexia. Mastication is impaired in the later stages, but otherwise the subjective symptoms are of but slight importance, owing to the fact that the growth is superficial to the gland, and to the more important vessels and nerves. If allowed to persist, the growth will finally take on malignant characters. True adenoma or fibroma of the parotid gland is occasionally observed.

FIG. 312.—MALIGNANT TUMOUR OF THE PAROTID GLAND.

(*b*) **Malignant** tumours of the parotid (Fig. 312) occur in the form of endothelioma, sarcoma, or carcinoma, and are not unfrequently grafted on to a simple tumour, the change of type being marked by increased rapidity of growth and greater pain. The mass becomes more fixed, and signs of pressure upon the vessels and nerves develop; the facial nerve very likely to be implicated, leading to paralysis of the face. Moreover, the skin becomes hyperæmic and often adherent to the tumour, and finally ulceration and even fungation may obtain. Secondary deposits occur in the neighbouring lymphatic glands or the viscera, and the patient soon passes into a state of malignant cachexia. Carcinomatous tumours are less common than the sarcomata, but run a similar course. The growth is an adenoid cancer not unfrequently of the soft or encephaloid type, and neighbouring lymphatic glands are early invaded.

The **Diagnosis** of simple parotid tumours from malignant growths is a matter of the greatest importance from a prognostic point of view, since simple tumours are distinctly encapsuled, and their removal, except in extreme cases, is not a matter of special difficulty, malignant disease is much more diffuse, rendering complete extirpation of the mass almost impracticable. The distinction between the two forms is made by a consideration of the signs and symptoms considered above, attention being directed to the rate of growth, the condition of the skin and surrounding parts, the mobility or not of the neoplasm, and the general aspect of the patient, whilst ass

paralysis of the facial nerve is almost always characteristic of malignancy. The lymphatic glands lying on the surface of the parotid, when invaded by tubercle or by epithelioma secondary to some intrabuccal growth, may closely simulate a true parotid tumour, but are recognised by their more superficial position.

The **Treatment** is often a matter of some difficulty, owing to the important character of the surrounding tissues. Removal should only be attempted if the skin is not extensively involved, if the growth is moveable on the deeper parts, and if there is no evidence of secondary deposits. Even simple tumours become irremoveable after a time on account of their deep connections and change of type, whilst it is seldom justifiable to touch malignant growths on account of their early and wide dissemination. *Simple* parotid tumours are dealt with either by making a vertical incision over the most prominent part of the mass, or by turning forwards a flap, exposing thereby the capsule, which is incised transversely; for although the facial nerve is generally beneath the growth, it occasionally runs superficial to it, or in its substance. After this has been accomplished, the tumour is often enucleated without much difficulty, but the surgeon must make certain that no deeper processes are left, or recurrence will inevitably follow. The hæmorrhage from the transverse facial and other arteries is free, but easily restrained. There is no need to remove redundant skin in these cases, as it quickly contracts.

FIG. 313.—SUBMAXILLARY TUMOUR (TILLMANNS.)

In dealing with early malignant disease *excision of the whole parotid gland* may be occasionally undertaken. It is accomplished through a vertical incision, or, if the skin is involved, by two crescentic ones. The gland is then gradually freed from its connections, care being taken, if possible, to keep outside its capsule. It is best to deal with the lower part first, securing with double ligatures the external carotid artery and temporo-facial vein. The mass is then drawn upwards and forwards, and its deep connections severed. The facial nerve is, of course, divided, and the patient must be warned before the operation of the necessarily resulting facial palsy. Recurrence is almost certain to follow. Removal of the angle of the jaw as a preliminary step has been recommended, since considerable space is gained thereby, and a better access to the field of operation.

Tumours of the Submaxillary Gland are very similar in nature to those of the parotid. Simple tumours are represented by endothelio-

mata, resembling cartilaginous or myxomatous growths, according to whether they are hard or soft (Fig. 313). Sarcoma and carcinoma are also met with; if seen in the early stages they are easily removed.

Salivary Fistula occurs almost solely in connection with the parotid gland. It arises from penetrating wounds of the cheek dividing Stenson's duct, or more frequently it follows operations in its neighbourhood. It is a very troublesome condition, both for the surgeon who is called upon to treat it, and for the patient who suffers from the inconvenience of saliva flowing down the cheek, the amount being, of course, increased at meal-times. Stenson's duct extends forwards from the socia parotidis across the masseter muscle for a distance of about 2 inches, and then turns abruptly inwards to pierce the buccinator, and enter the mouth opposite the second upper molar tooth. The buccal and masseteric portions are almost at right angles, the latter being represented by a line drawn from the lobule of the ear to a point midway between the ala nasi and the angle of the mouth. The diameter of the duct is about $\frac{1}{8}$ inch, its narrowest portion being at the orifice.

Treatment.—If the buccal portion is involved, a cure is often attained by slitting up the duct within the mouth; but when the masseteric portion is wounded, and especially if near the socia parotidis, treatment becomes more difficult. We have several times found the following plan successful: A fine probe is passed along the duct from the mouth as far as the lesion; it is then grasped by forceps inserted through the external aperture, and drawn out on to the cheek, a proceeding sometimes facilitated by slightly enlarging the wound. A double thread of silk is now tied to the end of the probe, and drawn through the thickness of the cheek, along the buccal portion of the duct, and out of the external wound. A fine drainage-tube is then carried along the same track, and left so as to project both externally and internally. A silk thread is attached to each end of the tube, and these are knotted together round the angle of the mouth. By this means a passage is re-established into the mouth, and as soon as it becomes easier for the saliva to travel along this than along the external wound, the fistula will close. At the end of a few days the outer half of the tube is removed, and only a silk thread allowed to occupy the outer portion of the fistula, which gradually contracts so that more and more of the saliva finds its way into the mouth. The silk thread and tube are then finally removed, and if the opening in the mouth is kept patent, the external wound soon heals. In those cases where the buccal portion of the duct is completely obliterated or obstructed so that a probe cannot be passed, a trocar and cannula are inserted through the external wound and cheek into the mouth; a silk thread is insinuated through the cannula, and a tube drawn into position, as in the former case. The subsequent treatment is the same as that indicated above.

Affections of the Palate.

Cleft Palate.—By cleft palate is meant a congenital defect of the roof of the mouth, whereby the structures entering into its formation do not unite in the middle line, thus allowing an abnormal communication to exist between the nose and mouth. The term does not include losses of substance, resulting from injury, syphilis, or lupus. The cleft usually starts posteriorly, and extends forwards for a variable distance, although it has been known to be limited to the anterior portion of the palate and bony alveolus, but only in exceedingly rare instance. The mildest cases consist merely of a bifid uvula, perhaps notsinvolving the palate at all; the next degree of severity affects the velum alone; more or less of the hard palate

A B C

FIG. 314.—VARIOUS FORMS OF CLEFT PALATE: A, INVOLVING MERELY THE VELUM; B, TRAVERSING THE HARD PALATE AS FAR FORWARDS AS THE ANTERIOR PALATINE CANAL; AND C, BEING COMPLICATED WITH A DOUBLE HARE-LIP.

may also be implicated, the cleft reaching as far forwards as the site of the anterior palatine canal (Fig. 314, B); whilst the severest type of the deformity extends in addition through the alveolus and upper lip on one or both sides, the os incisivum being in the latter case displaced forwards, perhaps on the tip of the nose (Fig. 314, C).

On looking carefully at a cleft palate, the defect usually appears to be mesial, but occasionally it seems as if a unilateral or bilateral fissure existed. To understand such an occurrence it must be remembered that three bony processes unite in the middle line of the roof of the mouth, viz., the two palatal processes growing in horizontally from the maxillæ, one on each side, and the ethmo-vomerine septum projecting vertically downwards from the under surface of the fronto-nasal process and base of the skull. All these should amicably join together about the ninth or tenth week of intra-uterine life. If, however, the palatal processes fail to reach the middle line, a median defect appears (Fig. 315, A), unless the ethmo-

vomerine septum be so hypertrophied as to project between them, when the appearance of a double cleft is produced (Fig. 315, B). When one division of the palate unites with the mesial septum, the other failing to reach it, an apparently unilateral cleft results; most commonly the defect is on the left side, the vomer being attached to the right free edge, a left-sided alveolar hare-lip also complicating the case (Fig. 315, C). The reason why the anterior portion of the palate is so rarely affected without the posterior part being also involved is that the union of the various segments progresses from before backwards.

The *width* of the cleft and the slope of the segments varies greatly in different cases. The wider the cleft, the more unfavourable it is for treatment by operative means; and this is one of the arguments

A B C

FIG. 315.—DIAGRAM TO SHOW THE MODIFICATIONS OF CLEFT PALATE.

a, Ethmo-vomerine septum; *b*, palatal segments; *c*, tongue; *d*, cavity of the nose; *e*, buccal cavity.

used in favour of the removal of the intermaxilla in cases of double hare-lip, so as to allow of the approximation of the two maxillæ. Remove it, and they fall naturally together; leave it, and they are wedged permanently apart. As to the *slope* of the segments, the more vertical they are, the more favourable for operation, since the flaps of muco-periosteum easily meet in the middle line. When the palate is more horizontal, and like a Norman rather than a Gothic arch, the flaps are shorter, and greater lateral displacement necessary to bring their edges into apposition; this involves much more traction on the stitches, and hence less satisfactory results.

The *effect* of such a deformity upon the infant, from a physiological point of view, is very serious. The process of *nutrition* is considerably impaired, owing to the fact that the power of suction is lost and fluids taken into the mouth are apt to escape through the nostrils instead of being swallowed. Consequently these children must be carefully spoon-fed with the head thrown well back, otherwise they become emaciated and succumb to inanition or intercurrent malady. If they grow up, *articulation* becomes so indistinct that it is often impossible to understand what they say, the voice having a peculiar and characteristic intonation. All the letters known as explosive

whether dentals, labials, or gutturals, requiring a certain amount of air pressure within the mouth for their due pronunciation, are difficult to produce, particularly *b*, *d*, *p*, *t*, *g*, *f*, etc. Moreover, the exposure of the nasal mucous membrane to the air is so much greater than usual that it is liable to catarrhal inflammation, resulting in the formation of scabs which undergo putrefactive changes and lead to a sort of ozæna. Both taste and smell are much diminished, partly from the unhealthy state of the mucous membrane, and also from the absence of an opposing surface against which the food can be triturated by the tongue. The *moral* effect of this deformity, particularly when associated with hare-lip, is such as to cause such patients to shun publicity from a nervous feeling of self-consciousness.

As to the best *period* at which to interfere by operation, considerable divergence of opinion exists. Some surgeons advocate its performance at as early a date as possible, and, in fact, it has been undertaken when the child was but a few days old. The success attending such practice has not been gratifying, since infants have no moral control, and are much more likely to suck at the stitches and interfere with them by the tongue, whilst the buccal cavity is small, and the tissues so delicate and friable that the difficulty of the operation is much increased. On the other hand, it should not be deferred too long; bad habits of articulation will be contracted, and subsequent physiological success, as gauged by the quality of the speech, is much less likely to follow. After an extended experience, it may be stated that the operation is best undertaken between the second and the third years, when a child can be easily kept under control. It is most important that the general health be good, and the mouth and throat free from local disease or inflammation. To guard against accidents it is well to make a routine practice of keeping a child under observation indoors for a few days before operating, whilst for choice the spring or summer should be selected. If the tonsils are enlarged, as is not uncommonly the case, it is by no means necessary to remove them if no active inflammation is present; pharyngeal adenoids, moreover, may sometimes be left with advantage, as they subsequently assist in shutting off the nasal cavity during speech.

Operation.—The child should be placed on a suitable table with a moveable headpiece, if possible, as it is often necessary to alter the position of the head during the proceedings. The arms are fixed to the sides by attaching them to a strap or bandage passed round the thighs below the trochanters, but the patient should not be tied down to the table, so that, although he cannot raise the hands to the mouth during the partial anæsthesia which is often present, yet he can be turned easily to either side so as to allow blood to run from the mouth. Anæsthesia is induced in the ordinary way by chloroform dropped upon the corner of a towel. The greatest care must be taken not to drop chloroform into the mouth, and even Junker's apparatus must be used with care, for fear of the chloroform vapour irritating the edges of the cleft. The mouth is efficiently

gagged open, and preferably by means of a unilateral instru which can easily be slipped in or out of position.

In a case involving both the soft and hard palate there reason why the whole cleft should not be dealt with at one si When the intermaxillary bone has been previously removed, considerable gap left anteriorly, it is often only possible to clo posterior two-thirds of the cleft, either dealing with the an portion at a later date, or trusting to the application of a su obturator, to which artificial incisors can also be attached. proceeding usually employed is practically identical with that duced by Langenbeck, and known as *uranoplasty*. For conve it may be described in four stages:

Stage I.: Incision and Detachment of Muco-periosteal Flaps.- knife should be inserted close to the last molar tooth and abou

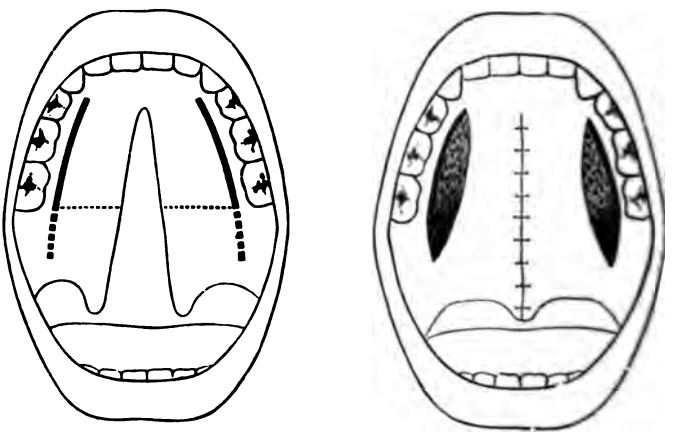

FIG. 316.—DIAGRAM TO INDICATE EXTENT OF INCISIONS IN URANO

The thick black lines show the primary incision; the thick dotted extension backwards of the same to relieve any lateral tensio dotted lines indicate approximately the position of the free bo bony palate. The right-hand figure shows the position of the s the condition of the parts at the close of the operation.

an inch from the alveolar margin, and carried forwards the teeth to a spot just anterior to the apex of the cleft alveolus is involved, the incision should stop behind incisor to preserve the vascular supply of the front (Fig. 316). The muco-periosteum is divided down to t by the use of a suitable raspatory the soft structures are stripped up towards the middle line, until the point ment is seen protruding into the cleft. Great care dealing with the hinder part to ensure its total detach hamular process and back of the bony palate, and yet it at this, its weakest spot. This must be thoroughly

either side, the extent of the incisions being shown by the continuous black lines in Fig. 316. Copious bleeding always accompanies this stage of the operation, and the head should be turned on one side and lowered, and the pharynx constantly sponged so as to prevent the blood entering the air-passages.

Stage II. : Paring the Edges of the Cleft.—This is accomplished by grasping the base of the uvula with a suitable pair of angular catch-forceps. Thus steadied and held, a thin paring can be removed, in one piece, if possible, on the side seized, and the same process repeated on the other. The paring of the edges is purposely deferred until after the muco-periosteal flaps have been detached, because the freshened edges do not thus get bruised by the frequent use of the sponge; moreover, the bevel at which the edges should be pared can be more accurately estimated when the flaps have been loosened.

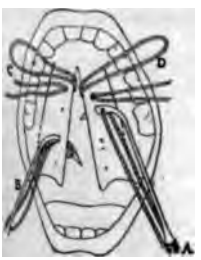

FIG. 317.

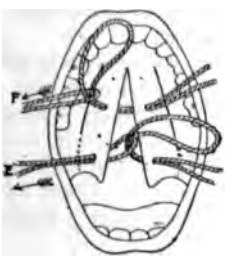

FIG. 318.

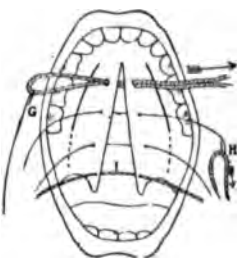

FIG. 319.

DIAGRAMS TO ILLUSTRATE THE LOOP METHOD OF PASSING STITCHES IN THE OPERATION FOR CLEFT PALATE.

The needles and silk thread are, for purposes of illustration, represented much thicker than would be really employed.

Stage III. : Passage and Tightening of Sutures.—The simplest plan to adopt is that known as the 'loop method' of Sir W. Fergusson, and it is carried out as follows: A long-handled palate needle with a suitable curve, and threaded with about 18 inches of fine white silk, is passed through the muco-periosteal flap from below upwards, and at a spot about 2 or 3 mm. from the margin (Fig. 317, A); as a rule, it is not necessary to hold the flap to effect this. The loop of silk projecting from the cleft (Fig. 317, B) is now grasped with smooth-nosed forceps and drawn out of the mouth, whilst the needle is withdrawn. A similar loop is inserted through the opposite side of the cleft at an exactly corresponding point, so that there are now two loops emerging from behind through the cleft (Fig. 317, C, D). One of these is loosely threaded through the other (Fig. 318, E), and the latter gently withdrawn, carrying with it the loop-end of the former (Fig. 318, F), and thus a double thread is carried through both sides of the palate, a loop projecting from one side, and the free ends from the other. This process is commenced anteriorly and carried back-

wards until the base of the uvula is reached, the stitches be inserted about half a centimetre apart, so that nine or ten thre may be needed to secure the whole palate. They are left loose, ends being held by the anæsthetist or assistant against the che until all have been inserted. A 6-inch length of fine well-annea silver wire is successively hooked over each loop (Fig. 319, G), dra into position by the silk thread (Fig. 319, H), and tightened t suitable degree by a wire-twister, so that the pared edges of the c are exactly apposed. This is best undertaken from before backwa Finally, the uvula is stitched with silk inserted by means of a doul curved needle (Fig. 319, I); silver wire would irritate the back of tongue too much and cause vomiting.

Some surgeons prefer to introduce the wire by means of a speci constructed hollow needle with a double curve, through which wire is protruded by unwinding a drum in the handle. This is pas through both flaps, commencing at the uvula, and working forwa tying each stitch as it is inserted.

Stage IV.—It is now only necessary to take steps for the *relief of lateral tension*, a most important and essential proceeding. The b way to accomplish this is to prolong backwards through the s palate the lateral incisions already made so as to thoroughly div the levator palati (see the thick dotted lines in Fig. 316). Oc sionally the anterior and posterior pillars of the fauces, contain respectively the palato-glossi and palato-pharyngei muscles, will a need to be snipped across.

The child should now be put to bed with the head low, so t any accumulation of blood or mucus may gravitate easily into pharynx. The mouth can be washed out with a weak solutic sanitas, although some surgeons prefer not to disturb the part three or four days. No nourishment should be given for the four or five hours, and but very sparingly for the first twenty Milk and water, given by a spoon or from a feeder, will for staple article of diet. By about the fifth day soft food, such as b bread and custard pudding, may be safely given. The patie generally allowed up on the sixth day. The silver stitches r left in for ten days or a fortnight without doing any harm.

In dealing with clefts of the soft palate alone, a modificatio above operation may be performed, called *staphylorraphy*. Th are first pared, lateral incisions are then made to divide the l palati, and the stitches finally passed and tied.

Results.—It is possible that in most cases articulation v anything, impaired as the immediate result of the operation mechanism which the patient ordinarily employs is thro gear; subsequent education at the hands of a voice-train lutely essential in order to correct this. Even then the articulation occasionally persists, owing to the patient be to draw up the velum so as to close the posterior nares; to a reduction of the depth of the soft palate owing to t required to close the cleft. In spite of this, however, th

is most beneficial in that it shuts off the nose from the mouth, prevents the dropping of mucus, improves the sense of taste, and adds greatly to the general comfort of the patient.

Davies Colley's Operation.—This plan of treatment, introduced by the late Mr. Davies Colley, consists in raising flaps of muco-periosteum (Fig. 320) in such a manner that whilst one is turned over and attached to the opposite margin of the palate with the mucous membrane upwards, the second flap is laid across it with its raw surface upwards—*i.e.*, in contact with the raw surface of the first flap. Suitable sutures fix the flaps in position (Fig. 321). As a rule, two or three subsequent operations are required to complete the closure of the defect. This proceeding has been much utilized by some surgeons, who perform it at a very early age; but we are not convinced as to its superiority over the plan described above.

Mechanical Treatment of clefts in the palate by means of obturators or artificial vela is still advocated by some surgeons and dentists in preference to

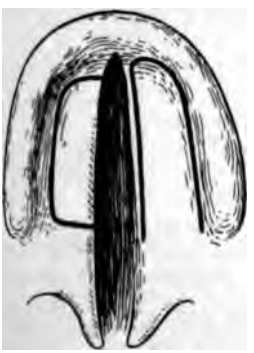

FIG. 320.—DAVIES COLLEY'S OPERATION FOR CLEFT PALATE.

The incisions for the muco-periosteal flaps are here indicated.

FIG. 321.—DAVIES COLLEY'S OPERATION COMPLETED.

The left-hand flap has been turned over, and its free margin stitched to the other side of the palate; whilst the right-hand flap has been dissected up and laid across the former with the raw surfaces in contact.

any operative interference. An *obturator* consists of an adjustable plate or plug fitted to and closing an aperture in the hard palate. It may be used with advantage in perforations due to traumatism or syphilis, and in apertures left after operations in which portions of the palate are removed, such as excision of the superior maxilla. In cases of double hare-lip and cleft palate, where the os incisivum has been extirpated, an aperture is often left anteriorly which cannot be satisfactorily closed except by an obturator, which also serves to carry the necessary artificial incisors, and may have cheek-plates attached to push forwards the upper lip. For whatever purpose an obturator is needed, it should never take the form of a closely-fitting plug, which, by its constant pressure and irritation, causes the aperture to become enlarged, but always that of a plate, either of thin vulcanite or gold, which can be fixed to the teeth, and maintained in position by suction. It is sometimes found, however, that the addition of an

intranasal projection to the upper surface of the plate improves the articulatio by diminishing the size of the nasal cavity. An *artificial velum* consists of a plat obturator, to which is attached posteriorly a moveable segment to take the plac of the normal velum. Such consists either of a hinged metal plate, resting o the nasal side of the segments of the soft palate, and moved by them, or of thin indiarubber bag filled with air, sewn to the back of the obturator. The are complicated and difficult to keep in order, and, to our minds, the results c operative interference are superior.

Ulceration of the Palate occurs in a variety of forms, *e.g.*, (*a*) *simpl* as an accompaniment of general stomatitis: (*b*) *syphilitic*, which ma involve either the hard or soft palate; if superficial, it is usually late secondary phenomenon; if deep, it involves the bones, and ofte leads to necrosis, and is then due to tertiary mischief: (*c*) *lupoid*, somewhat uncommon condition, which may result in great destructio of tissue; it is usually seen in children, and often associated with similar disease of the nose, from which, indeed, it may have spread (*d*) *tuberculous*, due to the breaking down of a tuberculous absces under the periosteum, and then complicated with caries of the bon palate: (*e*) *malignant*, usually resulting from the growth of epitheliom either starting primarily in the palatal mucous membrane, or ex tending to it from the tongue, tonsil, or upper jaw.

Acquired Perforations of the Palate, though occasionally caused b traumatism or lupus, are in almost all cases due to tertiary syphilis The ethmo-vomerine septum is often involved in the destructiv process, giving rise to a most offensive discharge from the nose. I the soft palate is alone affected, the velum may become fixed b cicatricial adhesions to the back of the pharynx, and pharynge stenosis or considerable loss of substance of the velum results. nasal intonation of the voice is always caused by any condition whi interferes with the closure of the naso-pharynx by the velum duri articulation. The *treatment* of these conditions should follow t usual antisyphilitic course. Perforations are best remedied by t use of plate obturators. We have seen out-patients make effici obturators out of a piece of sheet indiarubber maintained *in situ* suction, or of two pieces stitched together in the middle, one p passing above and the other below the opening. Occasionally w the aperture is small, the local disease soundly cured, and the ge health good, an attempt may be made to close it by strippin muco-periosteal flaps, paring the edges and suturing them toge The results are, however, seldom satisfactory.

Any of the ordinary forms of inflammation of bone may be with in the hard palate. **Necrosis** is usually due to tertiary sy or may accompany acute subperiosteal suppuration, extendin an alveolar abscess. In either case the surgeon must wait t sequestrum is loose, and then it may be removed. **Caries** is ge due to syphilis or tubercle.

The following **tumours** occur on the *hard* palate. **Simpl** (p. 812) may extend from the alveolus, or an identical conditi start in the middle line. An *adenoma* of the palatal glands i sionally met with. It presents as a smooth or papillated

somewhat resembling epithelioma, but distinguished from it by its slower rate of growth, and the absence of ulceration, pain, or glandular enlargement. An operation limited to the soft parts is probably all that is necessary. *Sarcoma* may be primary, and is then often myxo-sarcomatous in type, or secondary. In the former case it simulates rather closely a diffuse alveolar abscess, but is recognised by its slower growth, less pain, absence of inflammation, and, if need be, by the results of an exploratory puncture. *Epithelioma* also occurs, but is uncommon. Treatment for the two latter conditions, if limited to the palate, would consist in partial removal of the affected superior maxilla.

Elongation of the Uvula is frequently the result of a chronic relaxed throat. At first it merely lasts for a time, and by the use of astringents disappears; but later on the elongation becomes chronic, and causes great irritation of the back of the tongue and fauces, resulting in a troublesome throat-cough and even vomiting. Under such circumstances it should be removed. After well cocainizing the part, it is grasped by a pair of hook-forceps, which seize not only the mucous membrane, but also the muscular structures beneath, and a sufficient amount is then removed by snipping it across near the base with a pair of blunt-pointed scissors, leaving about a third of an inch of the organ behind.

Affections of the Tonsils.

Acute Tonsillitis results either from cold or from the inhalation of impure air, especially when contaminated with sewer gas. It is often seen amongst the residents in hospitals (hospital throat), and may precede an attack of acute rheumatism. Three varieties are described:

(*a*) *Acute superficial tonsillitis*, which consists of a slight superficial inflammation, the result of cold, etc., in which the tonsil participates with the pharynx and velum. There is but little swelling of the part, which, however, becomes red and painful, rendering swallowing difficult. Ordinary anti-catarrhal remedies are necessary, and a chlorate of potash gargle.

(*b*) *Acute follicular tonsillitis* is characterized by a general enlargement of the organ, which is dusky red in colour and painful, causing obstruction to both breathing and swallowing, the tonsils, perhaps, almost meeting in the middle line. There is a good deal of yellow patchy exudation from the follicles, which may coagulate on the surface and form a false membrane, distinguished from that of diphtheria by its want of adhesion to the subjacent tissue, being readily detached by a camel's-hair pencil. The temperature is high, the glands below the angle of the jaw become enlarged and tender, and may suppurate; the tongue is covered with a thick, whitish fur, and the bowels are confined. Such a condition may herald in an attack of so-called blood-poisoning, or septicæmia.

(*c*) *Acute parenchymatous tonsillitis*, or quinsy, is a more diffuse inflammation, which is not limited to the organ, but also involves the

soft palate and fauces. The swelling is more extensive, the pain is greater, and suppuration frequently results. Other symptoms are much the same as in the above.

The **Diagnosis** must be made from *scarlet fever* by the absence of the characteristic rash and red tongue of the latter condition, and by the redness being more dusky and less diffuse in tonsillitis. From *erysipelas of the fauces*, it is known by the redness being more concentrated, the œdema less marked and more limited, by the glands at the angle of the jaw being less enlarged, and by the absence of any external manifestation of the disease.

Treatment must always be commenced by a good calomel purge, which may be followed by the administration either of salicylate of soda (20 grains, thrice daily), or of chlorate of potash and sulphate of magnesia, to which a few drops of tincture of aconite may be added if the constitutional symptoms are severe. The patient will experience much relief by inhaling the steam from hot water (150° F.), in which a little creasote or carbolic acid is dissolved, or the tonsils may be scarified. Suppuration is dealt with by a free incision, the knife entering the most prominent part of the swelling, and cutting backwards towards the middle line; the close proximity of the carotid should not, however, be forgotten. Hot flannels or fomentations may be applied to the neck and throat, and plenty of fluid nourishment administered. This is followed as soon as possible by iron, bark, and other tonics.

Chronic Tonsillitis appears in two distinct forms:

(*a*) *Chronic inflammatory tonsillitis* occurs in children whose tonsils, after one acute attack, remain enlarged, painful, congested, and very liable to recurrence, which often runs on to suppuration and ulceration. After a time the tonsils shrink back and atrophy, becoming hard and fibroid.

(*b*) *Chronic hypertrophic tonsillitis* is met with in tuberculous children, resulting from an overgrowth of the lymphoid tissue, and is usually associated with the presence of adenoids in the naso-pharynx. The tonsils are enlarged, pale in colour, and firm in consistence; the orifices of the crypts are very patent, and in them are often seen plugs of mucous secretion, which may become infiltrated with lime salts, forming concretions, which, however, are never of any great size. The patients are very liable to recurrent attacks of inflammation, with or without suppuration, and even cysts may form from the blocking of the follicular ducts. When much enlarged, the tonsils may meet in the middle line beneath the uvula, causing obstruction both to swallowing and respiration. The patient usually breathes with the mouth open, owing to the concurrent naso-pharyngeal obstruction, and from the same cause speaks thickly, as if he had some loose body in the mouth, and necessarily snores during sleep. Hearing is often interfered with from the mucous lining of the Eustachian tube becoming thickened and inflamed.

The **Treatment** of these cases consists in first attending to constitutional weakness by removal of the patient to fresh or seaside air,

and by the administration of iron and cod-liver oil; at the same time the throat should be painted twice a day with glycerine of tannic acid, or with equal parts of glycerine and tinct. ferri perchloridi, or touched with the galvano-cautery. Failing this, tonsillotomy should be performed; in children the organ may be cut away as far back as possible, but in patients over the age of twenty only a thin slice should be removed, and never the whole organ, since there is much more risk of grave hæmorrhage; the galvano-cautery is much better treatment in adults. It has also been suggested that the voice is weakened by tonsillotomy, but this is somewhat doubtful.

Tonsillotomy may be undertaken in two ways:

(*a*) *By the guillotine.* The fauces having been carefully and repeatedly brushed with a 5 per cent. solution of cocaine, the mouth is opened and one of the many forms of tonsil guillotine introduced; Mackenzie's spade guillotine is as good as any. The ring of the instrument is passed over the projecting organ, external pressure behind the angle of the jaw assisting in this manœuvre. By the pressure of the thumb the projecting mass is cut off by the sharp blade. In dealing with the right side, unless the surgeon is ambidextrous, he had better stand behind the patient's head, looking over into the mouth.

(*b*) *By the bistoury.* The tonsil is seized at its lowest point and drawn well inwards by means of hooked forceps, and the projecting mass removed by a straight blunt-pointed bistoury, the base of the blade being guarded, if preferred, by a piece of plaster wrapped round it. The incision should be made from below upwards, and the edge of the knife kept rather in than out, so as to avoid all risk of wounding the internal carotid, which is in close contiguity to the outer surface of the gland. The surgeon must stand behind the patient's head in dealing with the right side, and in front when operating upon the left. Care must be taken to include the lowest portion of the tonsil, which often hangs down into the pharynx, and is liable to be left behind. In children the hypertrophic type of enlarged tonsil may be enucleated without much difficulty by dividing the mucous membrane in front of it, and shelling it out of its bed, the posterior reflection of mucous membrane being subsequently snipped through with bistoury or scissors.

The hæmorrhage, though brisk for the moment, soon ceases if care is taken not to cut too deeply, or encroach upon the surrounding mucous membrane. Should the bleeding continue, it can generally be arrested by douching the face with iced water, or by the local application of wool pledgets soaked in iced boric acid lotion, or in adrenalin; possibly a gargle containing hazeline may be efficacious in bad cases, or the galvano-cautery may be applied. This is more likely to occur in adults than in children.

Syphilitic Disease of the Tonsil is met with in various stages. The *primary chancre* is seen occasionally, arising in one case we know of through infection from a stick of caustic which had been previously used to cauterize a syphilitic ulcer and insufficiently cleaned before

pillars of the fauces, and presents a ragged ulcerated
a hard margin and sloughing base. It runs a rapidly
if left to itself. *Lympho-sarcoma* of the tonsil arises
itself, usually after middle life; it presents a smoot
appearance, the mucous membrane being stretched ove
soft and almost fluctuating. In the early stages it may b
able, but ere long it infiltrates surrounding structures, a
neighbouring lymphatic glands. *Round-celled sarcoma* al
tonsil as a primary growth, and is less limited and def
former. In all these varieties the growth extends into
impeding deglutition and respiration, and ulceration w
serious hæmorrhage may ensue; indeed, the latter co
a frequent cause of the fatal result.

Extirpation of Malignant Tumours of the tonsil is
ticable from the extent of the disease and the early
the surrounding structures, although it has now been sh
are more amenable to treatment than was formerly tho
case. The disease may be dealt with in two ways: (*a*) *I*
in the case of the loosely encapsuled and freely move
sarcomata. The capsule is divided preferably by a gal
and the growth shelled out sometimes with the utmost
very little hæmorrhage. Recurrence in the lymphat
however, almost certain to follow. (*b*) *From the neck.*
is to make an incision along the anterior border of the st
and carefully dissect down to the pharyngeal wall,
lymphatic glands which are enlarged or suspicious, and
external carotid or its anterior branches. The mass is
from the surrounding structures and removed. A goo
have now been reported which were treated in this
complete success, even when the tongue, palate, or

Affections of the Pharynx.

Acute Pharyngitis is usually associated with a similar inflammatory condition of the velum palati, nasal mucous membrane, and tonsils, and results from exposure to cold, from absorption of sewer gas, and from general diseases of the exanthematous type, *e.g.*, scarlet fever. It is characterized by redness, pain, and swelling of the mucous membrane, which becomes covered with mucus or muco-pus. An irritable cough, with perhaps sneezing, interference with nasal respiration, and great pain on swallowing, are produced by this condition, and if it spreads to the Eustachian tube temporary deafness is induced. Ulceration of the velum and fauces occasionally follows.

The **Treatment** consists in attending to the general condition, especially if of exanthematous origin, and when due to catarrh, in administering antiphlogistic remedies (*e.g.*, purgatives, sudorifics, and diuretics) and soothing local applications (*e.g.*, ice to suck, chlorate of potash gargle, etc.). Great relief is often given by inhaling steam from water at 150° F. to which a little Friar's balsam has been added.

Erysipelas of the Fauces and Palate has been already alluded to (p. 117).

Chronic Pharyngitis is commonly met with in clergymen and public speakers who are called upon to exert their voices for any length of time, in costers and street-hawkers who shout their wares, and in drinkers and smokers. It may commence as a chronic inflammation, or may follow an acute attack. The mucous membrane is more or less red and infiltrated, with vessels coursing over it, and there is often a good deal of muco-purulent discharge. If the buccal side of the velum palati is affected, there is usually much less secretion than from the pharyngeal aspect, where a considerable amount of dark-green viscid material may collect and cling to the pharyngeal wall, constituting scabs, which may decompose and cause the breath to be somewhat offensive. Two main varieties are described:

1. *Chronic Follicular Pharyngitis*, in which the lymphoid follicles scattered throughout the mucous membrane become enlarged. This is specially evident upon the soft palate, but is often greater in amount upon the upper wall and sides of the pharynx, where there is a mass of lymphoid tissue, sometimes known as the *pharyngeal or Luschka's tonsil* (*vide* Adenoids, p. 840). The uvula may be also elongated and hypertrophic in this condition.

2. *Chronic Atrophic Pharyngitis* is usually associated with the atrophic form of rhinitis sicca (p. 832), and possibly with chronic laryngitis. The mucous membrane is smooth, dry, and glazed, and the exudation forms adherent scabs. The throat feels dry and irritable, and the voice is often husky.

The **Treatment** of chronic pharyngitis varies with the condition and character of the affection. If of a simple type ('relaxed throat'), all sources of irritation—such as smoking, spirits, and condiments—

ammonium are recommended, or chloride of ammon
the nasal condition, however, is that which most needs

Syphilitic Affections of the Pharynx may be me
secondary or tertiary stages. In the former they are c
character, such as mucous tubercles, snail-track ulce
latter they appear in the shape of a *diffuse gummatous in*
is often of considerable consequence, both at the ti
quently. It manifests itself as a widespread nodular
the mucous membrane, especially in the neighbourhoo
and soft palate, which rapidly runs on to ulceration, ar
both respiration and deglutition. The administration c
iodide of potassium usually causes a rapid improve
subsequent cicatrization may bind down the velum
pharyngeal stenosis of such a character as to cons
cicatricial septum, with an opening through it perh
enough to allow a small bougie to pass. For such a c
may be done; the opening may be more or less dila
division of some of the bands and the passage of bou
soft palate can be set free from the dorsum of the tong
there is a great tendency for the opening to contr
treatment by bougies must be persisted in.

A *localized gumma* may form in the submucous tiss
quently involving the posterior pharyngeal wall, an
ordinary course with or without ulceration.

Tumours of the pharynx are rarely primary. They m
it, however, from surrounding parts, *e.g.*, naso-phar
arising from the base of the skull, or retro-pharyngeal
the spine.

Epithelioma either involves the pharynx primarily,
it from adjacent parts, such as the tongue or tonsil. T

Treatment.—It is only within the last decade that any attempt has been made to deal with these cases; even now the mortality is very high, and statistics go to prove that if the operation involves removal of portions of the upper or lower jaw, a fatal issue is likely to follow. The same precautions as to cleansing the teeth, immunization to streptococcal infection, etc., must be taken, as in dealing with naso-pharyngeal or buccal growths. As a general rule, an incision along the anterior border of the sterno-mastoid is the best to employ, although occasionally a second may be required, splitting the cheek towards the angle of the jaw. The external carotid is tied, all glands are removed, and then the growth is extirpated, partly from without, partly from within. It is always advisable to perform a preliminary tracheotomy, and feeding must be undertaken for some days by means of a stomach-tube. Trans-hyoid pharyngotomy is a useful means of approach in some of these cases (p. 913).

Retro-pharyngeal Abscess is acute or chronic in its course. The *acute* form results from infection through the mucous membrane, as by fishbones, etc.; or arises from an inflammation of the lymphatic glands which are found in this situation in children, but atrophy in adults, and derive their lymph from the interior of the nose and naso-pharynx. The *chronic* variety generally follows tuberculous caries of the spine, or disease of the bones at the base of the skull. Whether acute or chronic, the abscess forms a tense elastic swelling, situated behind the posterior pharyngeal wall; in the former case it is associated with high fever, and locally much redness and inflammatory œdema, which may even extend to the glottis, and cause dyspnœa; in the latter, where the affection is chronic, there is less local inflammatory reaction, but signs of cervical spinal disease are present. The abscess may burst into the pharynx, or may burrow outwards on either side, being guided by the pre-vertebral fascia, and point either in front of or behind the sterno-mastoid.

Treatment should never be delayed, from fear of the supervention of œdema of the glottis. The abscess should be opened from the neck in all cases, as then an aseptic course can be maintained, and there is no fear that the pus will enter the air-passages. If pointing in front of the sterno-mastoid, the abscess is opened in that situation; but otherwise an incision should be made along the posterior border of the muscle, which must be drawn forwards, and the transverse processes of the cervical vertebræ defined. Possibly the abscess will be opened by the necessary manipulation of the wound; if not, the index finger of the left hand should be placed against the abscess wall in the mouth to guard it from injury, and a pair of sinus forceps thrust into it in front of the vertebræ by the right hand. A drain-tube is then inserted, and the case runs an ordinary aseptic course.

Affections of the Œsophagus.

Malformations of the œsophagus are congenital or acquired.

A **Congenital** communication may exist between the œsophagus and trachea, either in the form of a small fistula, or the upper end of

age of thirty. They usually spring from the posterior
the junction of the pharynx and œsophagus, constituti
what is known as a 'pharyngocœle'; the cavity extend
between the œsophagus and vertebral column. The
due to distension of the cavity with food which stagnates
forming a swelling in the neck which can be emptied
the difficulty of obtaining sufficient food gradually leads t
When a bougie is used, it generally passes into the dive
hence its onward course is arrested; by careful manipu
be kept on the sound wall, and so slipped past the or
stomach. *Treatment*, where possible, consists in exposi
ticulum in the neck, removing it, and stitching up the o
pharyngeal or œsophageal wall. (*b*) *Traction Divertic*
rarer; they usually occur on the anterior wall, near th
of the trachea, and are due to cicatricial traction from v
an inflamed bronchial gland. They are always of sma
multiple, and cause no symptoms, unless a foreign bc
them, when ulceration and perforation may lead to
mediastinitis and death. They cannot be recognised *an*

Foreign Bodies not unfrequently lodge in the œsophag
in children and lunatics. Portions of food, coins, fis
plates of false teeth, etc., are the substances usually me
patient complains that something has lodged in the gul
feeling of pain and distension, whilst swallowing is pain
sible, and respiration may be more or less hampered.
are often impacted at the entrance to the gullet, an
sudden death from dyspnœa; if the obstruction is not
remains unrelieved, œdema of the glottis may supervene
lower down is likely to be followed by ulceration, pe
death, either from hæmorrhage owing to one of the

substance is impacted, it may be removed by œsophageal forceps, or by a coin-catcher. If it is impossible to draw it up, it may sometimes be pushed down into the stomach. A large bolus of food may be removed by forceps from the upper part of the œsophagus, and large foreign bodies—*e.g.*, plates of teeth—may be similarly extracted, though great care must be taken not to tear the mucous membrane. Radiography is now employed to assist in the localization of metallic substances such as coins, as also to determine whether or not they have been dislodged, whilst removal may be much expedited by the use of the radiographic screen.

If impacted in the upper part, *œsophagotomy* may be performed. An incision, 4 inches long, is made along the anterior border of the sterno-mastoid, preferably on the left side, because the œsophagus naturally curves that way. The platysma and deep fascia are divided, and the muscle drawn outwards; the omo-hyoid needs division, and the surgeon then carefully works his way between the carotid sheath on the outer side, and the larynx and trachea on the inner, avoiding the thyroid vessels and nerves. The projection of the foreign body will indicate the situation of the tube, and this is carefully incised and the obstruction dealt with. The œsophageal wound may then be closed by sutures which do not include the mucous membrane, whilst the external wound is either stuffed with gauze plugs or drained. When located in the upper part of the thoracic portion of the œsophagus the tube is opened as low as possible by cutting down on the point of a bougie passed from the mouth, and then it is often possible to extricate it.

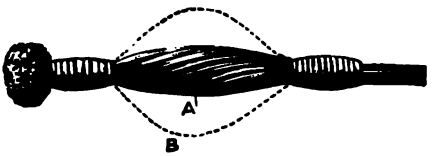

FIG. 322. — EXPANDING PROBANG FOR THE REMOVAL OF FOREIGN BODIES FROM THE ŒSOPHAGUS.

When the foreign body is impacted near the cardiac orifice, and cannot be moved either up or down, the stomach may be opened, the fingers or even the hand inserted into it, the cardiac orifice dilated, and the obstruction removed.

When once the foreign body has passed into the stomach, purgatives and emetics should be avoided, and if not of large size and irregular shape, the case is left to Nature, the treatment being merely expectant. The patient is kept quiet, and fed on pultaceous food—such as brown bread, porridge, etc.—and the motions are carefully examined. Should, however, the foreign body be large, and gastric symptoms develop, it should be removed by gastrotomy.

Inflammation of the œsophagus, with or without ulceration, is caused by swallowing corrosives or irritants, and, in a more localized form, by the impaction of foreign bodies. The symptoms are pain and difficulty in deglutition, and the treatment consists in the restriction of the diet to liquids, whilst in bad cases rectal feeding may be necessary. Chronic catarrh results from the continual drinking of raw

spirits, and stenosis from cicatricial contraction may gr follow.

Varix of the veins in the lower portion of the œsophagus i sionally met with as the result of pressure on the portal vein, cirrhosis of the liver. This is due to the fact that these b open into the gastric division of the portal system, passing t the œsophageal opening in the diaphragm. Hæmatemesis ma and has even proved fatal.

Spasm of the Œsophagus, or hysterical stricture, arises in r young women, usually under twenty-five years of age, and, a sometimes independent of lesion, is often associated wi slight abrasion or ulceration mucous membrane, perhap nated by the impaction at an date of a fishbone. The sy complained of are diffic swallowing, and a sensation ball arising in the throat *hystericus*), due to a spasmodi of the pharyngeal constrict cles. At times, when the p attention is diverted, deg occurs quite normally. Th course of *treatment* is anti-r in character (*e.g.*, cold dou the spine, massage, the adm tion of purgatives, valeria whilst the passage of a fu œsophageal bougie is useful.

FIG. 323.—CANCEROUS GROWTH OF THE (ESOPHAGUS. (TREVES' 'SURGERY.')

Organic Stricture of the Œ gus occurs in two forms—the and the malignant:

1. *Fibrous Stricture of th phagus* is usually located n commencement, just behi cricoid cartilage, and is m quently caused by the swa of corrosives, and the cicat of the wounds caused ther also results from syphilitic disease. At the cardiac orifice arise from the healing and contraction of a gastric ulcer. Th *symptom* produced is a gradually increasing difficulty in the sw ing, firstly of solids, but finally even of fluids. If the obstru placed at the upper end of the tube, food is returned immed but if lower down, the œsophagus may become dilated, and pouch or œsophagocele the food collects for a time, and then unchanged. There is but little pain in this form of stricture, al the patient is usually able to indicate the level of the obstr

As the case progresses, he becomes steadily emaciated from sheer starvation, and may even die from this cause.

2. *Malignant Stricture of the Œsophagus* is usually epitheliomatous in type, occurring in subjects over forty years of age, and situated either at the junction of the pharynx and œsophagus, *i.e.*, behind the cricoid cartilage (Fig. 323), or in the middle of the tube, where it is crossed by the left bronchus, or at the cardiac orifice of the stomach; in the latter site, columnar carcinoma is the form usually found. The growth involves the whole circumference of the tube, and sooner or later ulcerates, perhaps perforating the trachea, pleural cavity, or one of the large vessels. Secondary deposits occur in the lymphatic glands, either of the neck or posterior mediastinum, visceral complications being uncommon. The *symptoms* are similar in character to those of fibrous stenosis detailed above, but in addition the vomited materials may contain blood, and there is a good deal of cough and pain, referred usually to the site of the disease. Should the growth be at the upper end of the tube, a tumour may be distinctly felt, placed deeply in the neck and more marked on the left side; in the earlier stages nothing can be felt externally, although the side-to-side movements of the larynx may be impeded. Perforation of the trachea leads to the entrance of food into the air-passages, and rapidly results in septic pneumonia and death. When the upper part of the gullet is affected, the growth may spread to the back of the larynx, and cause hoarseness and even aphonia. Occasionally the pneumogastric nerves may be involved in the mass, leading to interference with the action of the heart, whilst implication of the recurrent laryngeal nerve causes constant cough and uni- or bi-lateral paralysis of the larynx.

The **Diagnosis** of œsophageal stricture must be made on general principles, and by a process of exclusion of the many other forms of dysphagia detailed below. It is confirmed by examining the condition of the tube with an œsophageal bougie. A conical-ended instrument of medium size should be employed for diagnostic purposes, and by this means the situation of the obstruction can be ascertained. *To pass an œsophageal bougie:* The surgeon stands in front and slightly to the right of the patient, who is seated with the head held forwards - if thrown backwards, the larynx is pressed against the spine, and the difficulty of introducing the instrument increased. The bougie is well warmed and smeared with glycerine, and, having been suitably curved, is guided by the surgeon's left index finger over the epiglottis into the œsophagus. This stage usually causes a certain amount of discomfort and retching on the part of the patient. Once past the entrance to the larynx, the bougie is pushed steadily onwards; if there is no stricture, the instrument will enter the stomach about 16 inches from the teeth. If any obstruction is present, the large instrument is withdrawn, and the passage of a smaller one attempted. The greatest care must be taken, especially in suspected malignant disease, as it is by no means difficult to perforate the walls and open up the mediastinal tissues, causing thereby a fatal cellulitis. A cancerous stricture sometimes feels rough and is painful; a simple stricture is

can take in the shape of strong broths, minced meat, or, if need be, rectal alimentation must be resorted t impossible to dilate, or if the stricture recurs, a *Sym* be inserted. It consists of a gum-elastic, funnel-shape through the stricture by a whalebone introducer, the against the face of the stricture. A thread attached t is brought out of the mouth in order to remove and ceeding needed about once a fortnight. (*c*) *Internal a* means of a concealed knife has also been attempte being divided posteriorly; it is a somewhat risk and is only feasible when the lesion is situated high (*d*) When the contraction is at the pharyngeal extrem possible to open the œsophagus below, and either div the stenosed portion, or *œsophagostomy* may be perfor the mucous membrane to the skin, thus forming an alimentary canal in the neck. Under these circun better practice to divide the œsophagus completely, cl end by sutures, and fixing the lower end to the margin (*e*) If the cardiac orifice of the stomach is contracted may be opened as in gastrotomy, and the fingers use stricture (*retrograde dilatation*), a proceeding similar operation for stricture of the pylorus. (*f*) Where proceedings are possible, or if tried have failed, the st opened, and division of the stricture by Abbé's *string* The patient is made to swallow one end of a piece small shot may be clamped on a piece of fine silk, and its way into the stomach. When this viscus is opene is secured, and by its means a coarse silk thread is ca the obstruction; by up-and-down sawing movements can be thereby divided, enabling the surgeon to intr Excellent results have been reported from such prac

alls of the tube. It may, however, be used as a temporary re in the earlier stages to enable the patient to take an ied amount of food, and thus for a time improve his general on and render him more fitted to undergo further treatment. ids' method of *tubage* may be utilized in malignant disease, the :s often bearing the inserted tube well, even when the cardiac is involved, the lower end then projecting into the cavity of mach. Unfortunately these tubes occasionally slip through ie stomach, or the guiding string is swallowed; moreover, the best circumstances the tube needs changing every fortnight, e ulceration may be increased thereby. Hence, *gastrostomy*, ned as soon as possible by one of the modern methods, is a more satisfactory plan of treatment. Excision of the growth neck has been successfully accomplished in a few cases when ease was recognised early, and very limited in extent. Trache- is occasionally required in the later stages, from implication of ittis or trachea.

e term **Dysphagia** is meant a condition in which swallowing is painful or . The **Causes** are very numerous, and may be arranged as follows:

ryngeal—*e.g.*, acute or chronic inflammation, whether simple, scarlatinal, ritic, etc.; ulceration of syphilitic or malignant origin; stenosis, as a f ulceration; paralysis (*e.g.*, labio-glosso-laryngeal or bulbar) or spasm; on of foreign bodies; naso-pharyngeal polypi projecting behind the retro-pharyngeal abscess or tumour, etc.

ryngeal—*e.g.*, acute or chronic laryngitis; tuberculous, syphilitic, or nt disease.

sophageal—*e.g.*, acute or chronic inflammation, impaction of foreign the presence of diverticula, œsophagospasm, and simple or malignant .

xtrinsic. In the *neck:* goitre, enlarged glands, aneurisms, etc.; in the mediastinal growths or glands, aneurisms of the aorta and large vessels, growing from the vertebral bodies, pericardial effusion, and displace- ckwards of the sternal end of the clavicle.

vestigate a case of dysphagia, note: (i.) the method of onset, whether acute nic—if the former, it is probably due to a foreign body; (ii.) the condition pharynx as seen from the mouth and on digital exploration; (iii.) the n of the neck as seen and felt from without, whether or not a tumour felt behind the cricoid, or whether a goitre or aneurism exists; (iv.) the er of the voice, as indicative or not of laryngeal mischief if the voice y, a laryngoscopic examination must be made; (v.) the chest must be y examined for aneurisms, etc.; (vi.) the œsophagus may be auscultated he vertebral groove whilst the patient drinks water to ascertain the n of the mischief; (vii.) it must be examined finally by bougies. If the tion is in the œsophagus, the patient's age and general condition will nd *facie* evidence as to whether or not it is due to malignant disease; but it t be forgotten that the stenosis *per se* causes some of the loss of flesh and ht. The presence of blood and offensive mucus on the bougie or in the l vomited, and the existence of enlarged glands in the neck, will also establishing a diagnosis.

AFFECTIONS OF THE EAR.

It is impossible to do more than deal with some of
portant surgical aspects of diseases of the ear in this pl
more detailed consideration of the subject we must ref
to special text-books.

The **External Ear** is the site of various affections whi
under the observation of the general surgeon. Thus, t
be **congenitally absent**, and even the external meatus
formation often associated with macrostoma. Nothing
for this want of development, and the surgeon must nev
to try and dig out the concealed membrana tympan
quently **accessory auricles** are present, consisting me
cartilage covered with fat and skin. **Large and promin**
stitute a very unsightly deformity, for which operativ
is occasionally required. The size may be diminished
a V-shaped portion from the upper part; the prominenc
a portion of skin and cartilage through an incision on
aspect. The wounds thus produced are accurately sut
and considerable improvement in the appearance result
of the ear is usually due to injury, but is occasionally
origin, especially amongst the insane. The auricle bec
and enlarged, and of a bluish-red colour in traumatic cas
unless inflamed it should not be interfered with, as a
although, if the appearance of the patient is importa
advisable to remove the blood, since its organization ar
contraction may lead to considerable deformity. **Ecze**
other inflammatory affections, are met with in the ext
pinna, but these call for no special mention.

Plugs of wax (cerumen), which become dark and i

A large syringe with a fine nozzle should be used, and a stream of warm water injected along the roof of the meatus; as it returns, the softened masses of wax are washed away. **Foreign bodies** in the meatus, such as buttons or beads, are similarly removed, if possible, by syringing; if this fails, a fine pair of forceps is employed for the purpose, but it must be remembered that behind the foreign body lie delicate structures, which can readily be harmed by the exhibition of impatience or force. Where all other plans fail, the auricle may be turned forwards and the meatus opened from behind. **Exostoses** are occasionally met with springing from the bony walls of the meatus; they give rise to deafness by obstructing the passage, and may be removed by the dental drill.

FIG. 324.—HÆMATOMA AURIS.

Affections of the Middle Ear.

Traumatic Rupture of the Tympanic Membrane is due to direct or indirect violence. The former cause includes the introduction of foreign bodies, or the ill-advised efforts of friends or even of medical practitioners to remove the same. The latter causes rupture of the membrane by the sudden compression of the air in the external meatus—*e.g.*, by boxing the ear, loud noises as from explosions or big-gun practice, or from diving. The lesion also occurs not uncommonly in fractures of the middle fossa of the skull. The patient complains of pain and deafness, and blood escapes from the meatus, but not to any great extent. On inflating the drum-chamber, as by Valsalva's or Politzer's methods, air can be heard to escape through the opening, perhaps with a whistling sound. As a general rule, these cases do well, the wound cicatrizing, and the hearing being fully restored; but the surgeon must at first give a guarded opinion, as there may be some deeper lesion which does not become apparent at first. The greatest care must be taken to sterilize the meatus, although it is not wise to use a syringe for the purpose; by this means infection of the tympanic cavity with pyogenic organisms may be prevented. A strip of gauze is gently inserted into the meatus, and an external dressing applied.

Otitis Media.—Inflammation of the middle ear is an exceedingly common affection, and constitutes the great bulk of all ear diseases. It must be remembered that the tympanic cavity is lined by a mucous membrane which is in direct communication through the Eustachian tube with that lining the naso-pharynx; and since this membrane is adherent to the periosteal lining of the cavity, every case of otitis media is likely to be associated with an internal periostitis of the temporal bone.

The *cause* is almost invariably an extension of inflammation along

in consequence of the inflammatory hyperæmia of its lini tympanic membrane bulges outwards into the meatus ruptures, the pain being at once relieved. The discharg or purulent from the first; in the former instance, if inf the meatus is guarded against, the inflammation may perforation heal, and no ill result follow. In many inst ever, especially when the child is suffering from measl resisting powers to microbic invasion are low, pyoger follows, and the catarrhal otitis media is transformed int tive lesion, which may persist as a *chronic otorrhœa* fo period, and may lead to the most serious, and even fatal, intracranial complications which arise in its sequence.

It is therefore obvious that the greatest care should be **Treatment** of all cases of acute otitis media. In the fir possibility of infection from the external meatus must against by thoroughly purifying it; the external ear is with soap and water, and the meatus is filled with 1 in lotion, which is allowed to soak in and act for some m antiseptic dressing is then placed within and over it. kept in a warm room, and his general condition attended t diet, diaphoretic medicine, and a smart purge. In mild ca behind the ear will often act beneficially, whilst in mor leeches may be applied. Solution of cocaine or drops c instilled into the meatus may relieve pain, and in adult possible to cocainize the orifice of the Eustachian tube in thereby relieving the hyperæmia and opening up the tu giving an exit to the retained discharge. Pain is often fomenting the ear or by the application of dry heat, as in a hot-water bottle or a baked bran-bag.

When the membrane is seen (by speculum) to be bulgi

catarrhal otitis media. The membrane is perforated, and the discharge varies in amount and character. In uncomplicated cases, treatment consists in: (1) Improvement of the general health, as by the administration of tonics, residence in fresh country air, and avoidance of chills. (2) The naso-pharyngeal condition must be attended to, so as to ensure a patulous condition of the Eustachian tube, by which discharges may escape. Gargles may be ordered, and adenoids and enlarged tonsils may require removal. (3) The middle ear must be kept free from any accumulation of discharge which might undergo decomposition. When the discharge is abundant, external syringing with boiled water or weak boric acid solution is needed, and the tympanic cavity is inflated from the Eustachian tube by Valsalva's method, Politzer's bag, or even the Eustachian catheter, once or twice a day. If the discharge is slight, the meatus may be packed with boric acid powder, and syringing avoided. Not unfrequently, however, a persistent discharge from the ear is due to some of the complications mentioned below, and further operative treatment may be required.

The methods of inflating the tympanic cavity mentioned above require a word of explanation.

Valsalva's Method consists in closing the lips, holding the nose, and expiring forcibly; the air is thereby driven up the Eustachian tubes if they are patent.

FIG. 325.—EUSTACHIAN CATHETER.

In **Politzer's Method** an indiarubber bag with a teat-like end is introduced into one nostril so as to occupy it completely. The other nostril is closed by the surgeon's finger. The patient is instructed to take a sip of water and to hold it in the mouth with closed lips until told to swallow. As he swallows, the bag is forcibly compressed, and air is thereby driven up the tubes. An auscultating tube may pass from the patient's meatus to the surgeon's ear, and various sounds, whistling, bubbling, etc., may be detected, according to the character of the lesion.

The **Eustachian Catheter** (Fig. 325) can be passed into the Eustachian tube, and the degree of inflation more accurately controlled. The instrument, carefully sterilized, is passed with the beak downwards along the inferior meatus of the nose until the posterior pharyngeal wall is reached. 'As soon as its tip touches the posterior wall of the naso-pharynx, the *anterior end* of the instrument is slightly raised, and is withdrawn for about half to three-quarters of an inch until the beak is felt to be in contact with the posterior end of the hard palate. The catheter is then rotated through a quarter of a circle until the beak points directly outwards. It is then pushed a little onwards, and is usually felt to slip easily into the opening of the Eustachian tube' (Lambert Lack).

The **Surgical Complications of Chronic Otorrhœa** are frequently serious, and call for prompt treatment; they may be classified under three main headings—the extracranial, the cranial, and the intracranial.

owing to the denseness of the tissues involved. The fomented, and opened when pus has formed.

(*c*) Inflammation may occasionally spread from the m tympanic plate of the temporal bone, leading to subperios and necrosis; or it may extend into the temporo-maxill tion, giving rise to suppurative arthritis and disorganiza joint (p. 824).

The **cranial complications of otitis media** are often nature, and may end in permanent deafness, or even e life of the individual.

(*a*) The **ossicles** frequently necrose, and are cast off charge, and thus hearing may be impaired, although not destroyed; ankylosis of the ossicles one to another m determined, leading to considerable loss of function.

(*b*) The inflammation may extend from the lining m the tympanum to the bony walls surrounding it, givin limited **caries** or **necrosis of the temporal bone.** This sociated with suppuration within the skull, and any o cranial complications mentioned below. The roof of th cavity (*tegmen tympani*), which is very thin, is especially affected in this way. If diseased bone can be felt external auditory meatus with a probe, an attempt shou to remove it; if this is impossible, the part must be ke the injection of mild antiseptics, retention of discharges vented by the regular use of Politzer's bag.

(*c*) **Polypi** may also develop, consisting essentially of tissue protruding through the opening in the membran to considerable obstruction, and may do harm by keepi discharge. They should be removed by the curette, a bone, usually felt at their base, scraped; the part is s

regularly faradized, so as to maintain as far as possible the tone of the muscles.

(*e*) Inflammation may also extend into the mastoid cells, giving rise to the condition known as **mastoiditis**. The mastoid process is a triangular mass of bone, which is practically undeveloped until the age of puberty. Before that period a single cell relatively of large size communicates with the posterior portion of the tympanic cavity and represents the antrum; it is comparatively superficial, being immediately under cover of the squamous flake of bone, and is in reality petro-squamosal rather than mastoid in origin. After puberty the whole bone becomes hollowed out into a series of spongy cells, lined with mucous membrane, which open into the floor of the antrum. These cells lie below and superficial to the antrum, which is therefore more deeply placed in the adult than in the child. The communication with the tympanic cavity, which in a child is widely open, becomes encroached on and narrowed to a small track in the adult. When the inflammation in otitis media, which has almost always become septic, extends into the antrum, severe local and general symptoms are likely to result. The patient complains of intense pain in the ear, with tenderness on pressure, and perhaps redness and œdema over the mastoid process. The discharge from the ear often ceases for a time at the commencement of these symptoms, but reappears later on. As the case progresses, febrile symptoms of an intermittent type, and even rigors, may supervene, whilst the patient becomes drowsy, or may be irritable and restless. An abscess may form under the periosteum covering the mastoid process, with or without caries or necrosis of the outer table of the bone; in children, where this bony lamella is thin, it is not unfrequently absorbed, and on incising the abscess protuberant masses of granulations, springing from the interior of the bone, may be seen. When an abscess has developed, the auricle is characteristically displaced downwards and outwards. Any of the intracranial complications mentioned below may occur as sequelæ. Occasionally the mastoid trouble is of a more chronic type, and even tuberculous in nature, the cells being choked up with lymph and inflammatory material of a cheesy nature, whilst the bone itself becomes thickened and condensed. The process feels distinctly enlarged, and a good deal of deep-seated pain of an aching character is experienced, and worse at night.

When the discharge is inspissated and mixed with epithelial cells and cholesterine, so as to form flaky masses like the layers of an onion, the condition is known as *cholesteatoma*. It is often the cause of great distension of the antrum, which in a case operated on by one of us measured quite 1½ inches across. The symptoms, at first of a chronic type, are likely to be followed sooner or later by an acute attack of septic inflammation.

Treatment.—In the early acute stage belladonna fomentations may be employed, and the patient kept quietly in bed, whilst the diet is regulated and a suitable purgative administered; accumulated dis-

charge is removed from the tympanum by the use of Politzer's ba Two or three leeches may also be applied over the mastoid proces and relief to the pain thus obtained, though it is often only of temporary character. It is most important not to rely upon su palliative measures for too long, but when the symptoms are w marked, even in the early stages, and before suppuration h occurred, it is good practice to make an incision (*Wilde's incisio* down to the bone, reaching from the base to the apex of the proces much relief is always obtained by this procedure, and the inflan matory phenomena are sometimes completely checked. As a rul however, the mastoid *antrum must be laid open* and its conten evacuated (*Schwartze's operation*). Many instruments have be

FIG. 326.—INCISION FOR MASTOID OPERATIONS.

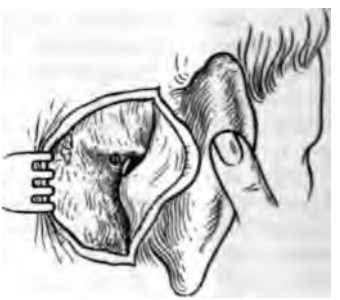

FIG. 327.—SITE FOR DRILLING BONE IN ORDER TO OPEN THE MASTOID ANTRUM.

It is often well to apply a chisel over the desired area so as to include a triangl the centre of which corresponds to the apex of the so-called supra-meat triangle. As soon as the outer layers of the bone have been removed by th chisel, the gouge is used to reach the deeper parts.

suggested in order to accomplish this; thus, it has been recom mended to use the bradawl, trephine, gouge, or gimlet; the gou is, however, probably the best, if a burr worked by a surgical engi is not obtainable. A curved incision is made immediately behind th ear, which is drawn well forwards (Fig. 326), and the gouge appli on a level with the roof of the external auditory meatus, and abo ½ inch behind its centre (Fig. 327). A small dimple in the bone c often be felt at the required spot, which can also be found by takin the point of junction of two lines drawn as tangents to the roof an posterior wall of the bony meatus respectively (Fig. 281, C). Th direction taken by the gouge should be slightly downwards, forward and inwards, and a useful guide will be found in a probe pass down the external auditory meatus, the boring being made exact parallel to this. In an adult the mastoid antrum is reached abo three-fifths of an inch from the surface of the bone. The surge recognises that he has opened the cavity by the loss of resistan and the escape of exceedingly offensive pus. The opening is th

freely enlarged by the use of the gouge and cutting-pliers, and the cavity syringed out through the external meatus. Diseased bone in the mastoid process or around the tympanic cavity may be scraped away, and the wound plugged with sterile gauze; it should be syringed through from the external meatus daily. In the more chronic cases it may be advisable to split off the whole of the outer coating of bone from the mastoid process, so as to lay open all the cells, which will often be found filled with inspissated pus.

In the more severe forms it is recommended to detach the auricle posteriorly from the bony margins of the meatus, and then to gouge away the whole of the osseous tissue intervening between the meatus and tympanic cavity in front and the mastoid antrum behind. A

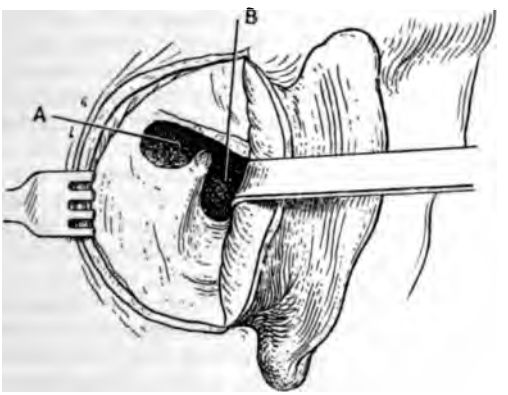

FIG. 328.—STACKE'S OPERATION COMPLETED.

The antrum (A) has been thoroughly opened up, and the bridge of bone covering the aditus removed, thus bringing the antrum into free communication with the tympanic cavity (B), which is curetted and the ossicles removed.

metal guide is passed from the opening in the antrum into the attic along the aditus, and all the bone superficial to the guide may be safely removed. The facial nerve and superior semicircular canal lie behind, and are protected by the guide. The remains of the membrane and the ossicles are then removed, and the whole cavity well curetted (Fig. 328). The deep portion of the posterior wall of the cartilaginous meatus is incised longitudinally and the margins of the aperture stitched to the posterior edge of the wound, the meatus thus leading to the whole of the opening in the bone, which can in this way be syringed out and cleaned more efficiently (*Stacke's operation*). The results of this proceeding have been very satisfactory, but the proximity of the facial nerve must never be forgotten, and the anæsthetist should be instructed to watch the face continuously for any twitching, which indicates that the nerve is being touched, inasmuch as the surgeon is working at the side, and cannot see.

The **intracranial complications** of otorrhœa are subcranial abscess,

localized or diffuse meningitis, thrombosis of the lateral sinus, and abscess in the cerebrum or cerebellum.

(*a*) **Subcranial Abscess.**—For general phenomena connected with this condition, see p. 781. Accumulations of pus occur most commonly along the summit of the petrous portion of the temporal bone, and in the sulcus in which the lateral sinus is lodged. The patient complains of pain and headache, which increase for a time and are then followed by drowsiness, which may pass into coma. The temperature is usually raised, but rigors, even if present at first, are by no means a constant feature of the case. The pulse is of the usual febrile type, viz., quickened, full and bounding. There is no pain in the neck along the course of the jugular vein, but retraction of the head occurs if basal meningitis is present, and vomiting is a marked symptom. Optic neuritis may be observed in consequence of the inflammation extending to the membranes at the base of the brain. There may be some tenderness on pressure over the temporal region, and possibly œdema. In some cases the pus finds its way outwards along the mastoid emissary vein, or through the suture between the occipital and temporal bones.

The **Diagnosis** from *cerebral abscess* is sometimes a matter of considerable difficulty. The symptoms, however, set in somewhat more acutely, whilst the temperature is raised, and the signs of irritation of the membranes, such as retraction of the neck, all suggest that the lesion is extradural, and not cerebral in origin. The pulse is fast, and not slow, and focal symptoms are less likely to develop.

The **Treatment** consists in trephining above and behind the meatus, so as to escape the lateral sinus, and in much the same situation as for a temporo-sphenoidal abscess (*q.v.*). The pus is washed out, and a drainage-tube inserted for a few days.

(*b*) **Meningitis** may be localized or diffuse. The former often accompanies some other condition, and is in itself of little moment. It may produce fixed headache, but, if non-suppurative, usually disappears when the originating disease has been cured. The diffuse variety is generally septic in nature, and secondary to some suppurative affection in the neighbourhood, or to thrombosis of the lateral sinus. For symptoms, see p. 782. Occasionally a simple serous effusion occurs within the meninges, leading to increased pressure and consequent drowsiness, but disappearing entirely when the cause has been removed.

(*c*) **Thrombosis of the Lateral Sinus** arises from direct extension of the inflammatory process from the middle ear through the mastoid bone, or it may be set up by a septic thrombosis of the mastoid emissary vein spreading to the sinus. A clot forms within it, which, gradually increasing in size, leads finally to occlusion of its lumen. Infection with pyogenic organisms determines disintegration of the clot, septic emboli are detached, and thus pyæmic symptoms originated. In well-marked cases the thrombus extends as far back as the Torcular Herophili, and downwards along the jugular vein.

The most marked **Symptom** of the case is the sudden appearance

of a high temperature, which is usually remittent, and associated with rigors, vomiting, and localized pain in the head, perhaps most marked over the point of emergence of the emissary vein at the posterior border of the mastoid process. The pulse is slow and easily compressible, and in the later stages the patient is drowsy and dull, probably from serous exudation within the meninges. The discharge from the ear, which may have been previously offensive, usually ceases. Optic neuritis may or may not exist, being often preceded by photophobia. If the thrombus extends into the neck, a firm, tender, elongated swelling is felt in the region of the jugular vein, and, owing to the interference with the venous circulation, the face often becomes dusky. Stiffness of the muscles at the back of the neck is an evidence of a certain amount of associated basal meningitis, as is also the optic neuritis. Suppuration may occur outside the sinus, or around the vein in the neck, which becomes swollen, red, and œdematous.

In well-marked cases the **Diagnosis** is easily made, but in the early stages, and especially in children, it is often a matter of some difficulty. The abrupt onset, the oscillating temperature, the recurrent rigors, the pain in the neck, and the deep tenderness on pressure over the course of the lateral sinus or jugular vein, are the most trustworthy signs of this affection.

Treatment, to be successful, should be undertaken early. The skull is trephined at a spot about ¼ inch above Reid's base-line, and about 1 inch behind the centre of the external auditory meatus (Fig. 281, A or B). The outer wall of the sinus is thereby exposed, and a puncture with a fine needle readily determines whether it contains fluid blood or thrombus. If it is thrombosed, there is often some evidence of inflammation or pus around it, between the dura mater and the bone. Having thus verified the diagnosis, an incision is made along the anterior border of the sterno-mastoid, through which the jugular vein is tied at a spot below the lowest point of the thrombus, so as to prevent the escape of any more emboli into the general circulation. In old-standing cases this may involve exposing the vein in the lowest part of the neck, and placing the ligature close to the innominate. The lateral sinus is now freely opened, and the septic thrombus partly scraped, partly washed away, additional bone being taken away if necessary. It is desirable, but not essential in the simpler cases, to remove completely the lower part of the thrombus; if such is attempted, the jugular must be opened above the ligature, and the clot syringed or scraped away. Bleeding occurs from the posterior part of the upper opening as soon as all the coagulum is removed, but is easily controlled by plugging the sinus with a small piece of aseptic sponge or gauze. The wound in the neck should be lightly stuffed and not closed, since septic infection and suppuration are almost certain to follow. The upper wound is also packed in the same way, and allowed to granulate.

(*d*) **Abscess** in the cerebrum or cerebellum, a complication not unfrequently met with, has been already discussed (p. 785).

CHAPTER XXXI.

SURGERY OF THE NECK.

Affections of the Neck.

Affections connected with the Branchial Clefts.—In the se
intra-uterine life a series of branchial arches form in the
other mammalia, constituting the foundation from which th
the neck are developed. In the majority of mammals five
occur, separated from one another by the so-called branchi
the fourth and fifth are amalgamated. They project fr
primitive spinal column, and consist of mesoblast line
epithelium. They unite across the median line at an earl
with another, thereby leading to a large extent to the obli
Occasionally, however, this union is imperfect, and sundry

It must be remembered that the mandible and the pro
malleus arise from the first arch; the Eustachian tube, tym
auditory meatus, and Glaserian fissure from a normally
of the first cleft; the styloid process, stylo-hyoid ligament
the hyoid bone from the second arch; the body and grea
bone from the third arch; and the rest of the cervical tissue
arch; whilst the second, third, and fourth clefts are, unc
stances, totally obliterated.

Branchial Fistulæ are due to imperfect closure of the br
consist of narrow sinuous tracts extending inwards from t
communicating, but not necessarily so, with the pharynx.
is usually situated along the anterior border of the stern
commonly near its lower end, close to the episternal n
arising from the lowest cleft. They are lined with epith
glairy or mucoid fluid. They are not uncommonly a
abnormalities, such as macrostoma, absence of the pinna,
situated either near the orifice of the fistula or close to the
of cases they may be disregarded, but if troublesome sho
the lining membrane either dissected away or destroye
cautery.

Branchial Cysts arise from incomplete closure of a

ted, in character. The most common situation is in the third then lying between the thyroid cartilage and the anterior border nastoid, in relation with the great wing of the hyoid bone; when they may extend beneath that muscle, displacing it outwards. cyst arises from the second cleft, being then located in the upper ck, and tending to spread up towards the styloid process; it may m the mastoid process to the hyoid bone, running parallel to the r of the jaw, and fluctuation may be detected through the mouth. sts in extirpation when the condition has attained sufficient size me.

rcinoma.—Considerable doubt has been expressed as to whether for carcinoma to originate in the unobliterated remains of the s, cases which might have been considered of this nature being velopments of epithelioma in the deep lymphatic glands which ie cystic degeneration, and secondary to some undiscovered or in the pharynx or larynx. The balance of evidence is, however, e fact that carcinoma can start in this way, giving rise to what ribed as a *malignant cyst of the neck*. It is characterized by the tumour placed deeply beneath the sterno-mastoid, indefinite in firm consistence. Considerable pain is experienced, and lymphatic secondarily enlarged. The disease runs its ordinary course, but e through hæmorrhage from the main vessels, which are invaded r. The cyst sometimes gives way into the pharynx, and a r of the pharyngeal wall is thus induced. Pathologically, the interesting one, since the tumour does not always possess the n epithelioma. Its embryonic origin is sometimes indicated by yxomatous and cartilaginous tissue is included in its substance.* ually impracticable owing to the deep connections of the growth.

r congenital conditions may be met with in the neck. **Congenital the sterno-mastoid** in all probability arises from injury during l usually occurs in head presentations, probably from bruising of neck against the under surface of the symphysis; it is said to be on the left side than on the right. In cases that have been oscopically, the indurated mass has been found to consist of It disappears spontaneously after a time, but may lead to later date. The congenital form of **torticollis** (p. 420), **cysts** in h the thyro-glossal duct, and **cystic hygroma**, may also be

Cysts of the Neck.

Congenital Origin.—(*a*) *Dermoids* occur here as in any other congenital remains are found. As already mentioned, velop from the branchial clefts, but may also be found le line, or in connection with the thyro-glossal duct. *glossal duct* (Fig. 329) consists of a tubular outgrowth oryonic pharynx passing downwards behind the body of ie in front of the larynx and trachea as far as the isthmus id gland, which is subsequently developed from it, and he lateral lobes, which in turn spring from the deeper branchial arches. The upper end of this duct is situated nen cæcum of the tongue, and thence traverses the f that organ between the genio-hyo-glossi muscles to oid bone; the lower end is represented by the pyramid of isthmus. The whole of this tube disappears under

logical report of a case see Veau, *Revue de Chirurgie*, March, 1900.

ordinary circumstances; if, however, the upper part remains unobliterated, a dermoid cyst may originate from it, placed either in the substance of the tongue or immediately below it (p. 855). If the lower portion remains patent, a cyst develops containing mucoid or glairy fluid, which, however, is not present at birth. If it bursts spontaneously, or is opened, a so-called *median cervical fistula* results, which requires the same treatment as a branchial fistula, viz., incision, and complete removal or destruction of the epithelial lining. Accessory thyroid growths of an adenomatous nature may develop from any part of the duct, but especially from the lower end; they are quite innocent in nature, and unless troublesome may be left alone. (*c*) *Cystic hygroma* is sometimes congenital, but may also be acquired. It consists of a multilocular swelling, the spaces composing it being due to dilatation of lymphatic spaces, and filled with lymph. The tumour is often of considerable size, with a sinuous, irregular outline, and may produce great deformity and marked pressure effects. The skin over it may be occupied by dilated capillaries or lymphatics. Unless extending to inaccessible parts, such as the superior mediastinum, it should be dealt with by excision (p. 358).

FIG. 329.—MEDIAN SECTION OF TONGUE, LARYNX, AND TRACHEA, SHOWING THYRO-GLOSSAL DUCT EXTENDING FROM THE FORAMEN CÆCUM OF THE TONGUE DOWNWARDS BEHIND THE HYOID BONE, AND IN FRONT OF THE TRACHEA TO THE ISTHMUS OF THE THYROID BODY. (SEMI-DIAGRAMMATIC, FROM COLLEGE OF SURGEONS' MUSEUM.)

A small dermoid cyst in the centre of the tongue is also represented.

2. **Acquired Cysts of the Neck** are of the following types: (*a*) *Sebaceous cysts* develop in the skin as elsewhere, but need no separate notice. (*b*) *Bursal cysts* are stated to occur in connection with the larynx and hyoid bone. There is usually a bursa over a prominent thyroid cartilage, which might easily be mistaken for one of Adami, and this may become enlarged and distended with fluid. A bursa also exists between the back of the hyoid bone and the thyroid cartilage, which might easily be mistaken for one of thyro-glossal origin. In doubtful cases a microscopical examination of the lining wall will quickly settle the diagnosis, since if it is bursal in origin it is lined with endothelium, whilst if it is thyro-glossal it is lined with epithelium. In the former case incision and drainage usually suffice to bring about a cure, although excision is preferable; in the latter case the lining wall must be entirely removed. (*c*) Un

locular serous cysts are sometimes met with in the lower part of the posterior triangle, constituting the condition known as 'hydrocele of the neck.' They contain serous fluid, with perhaps an admixture of blood. Their origin has not been defined with any certainty, but they are probably due to a dilatation of the lymph spaces, and are best treated by excision. (*d*) *True hydatid cysts* also occur in this region (p. 220). (*e*) *Blood cysts* have been found in close connection with the large vessels of the neck. They are possibly due to the dilatation of a vein, and may communicate or not with some vascular channel, such as the jugular, being then partly emptied on pressure. Where no communication with a venous trunk exists, the lining membrane is intensely vascular. In the former case they may be treated by excision, securing the vessels with which they communicate above and below; in the latter tapping and injection of perchloride of iron may suffice, or they may be opened and stuffed. (*f*) Cysts are also occasionally met with in connection with the *salivary* glands and the *thyroid* body. (*g*) *Malignant cysts* arise, as already mentioned, from the remains of the branchial clefts, or from a degeneration of epitheliomatous lymphatic glands. They are often of large size, and their removal is impracticable owing to the adhesions which they contract to the deeper structures.

Cut Throat.

Injuries of the neck are commonly met with in cases of attempted homicide or suicide, and vary much in severity according to the extent and position of the wound. A right-handed suicide usually cuts his throat from left to right, and therefore the incision is bold and clean on the left side, tailing off towards the right; in a left-handed suicide the incision runs in the opposite direction. A homicidal cut throat varies in its direction according to whether it is done from behind or in front, and also with the hand employed. If the front of the neck is mainly involved, the air-passages are laid open, and the patient's life, though much endangered, is not necessarily destroyed. If, however, the wound chiefly affects the side, the great vessels and nerves may be divided, and death from haemorrhage is very liable to ensue. The course and treatment of the latter class of case require no particular notice, since the general principles relating to all wounds must be adhered to. Where, however, the air-passages have been opened, special complications arise, requiring suitably modified treatment.

Wounds involving the Air-passages, the result of cut throat, may be situated at four different levels: (*a*) above the hyoid bone, encroaching on the base of the tongue; (*b*) through the thyro-hyoid space, the most common situation; (*c*) in the larynx; and (*d*) opening or dividing the trachea.

The **immediate effects** of such lesions are due to shock, haemorrhage, asphyxia, or the entrance of air into veins. *When above the hyoid bone*, the root of the tongue and submaxillary region are involved,

and hæmorrhage from the lingual or facial arteries or their branches follows; if the wound extends far enough, the main vessels are divided, and death results. In the less severe cases the patient runs considerable risk of being suffocated by the epiglottis and base of the tongue falling back over the larynx. Much difficulty will be subsequently experienced in feeding the patient, owing to impairment of the movements of the tongue. When the *thyro-hyoid* space is opened, the origins of the facial and lingual arteries are again in danger, as also the upper part of the superior thyroid. The base of the epiglottis is divided, and portions of mucous membrane around the entrance of the larynx may be detached, and cause obstruction to respiration. Blood may also trickle down the larynx into the trachea, and lead to asphyxia. Wounds of the *larynx* are usually transverse, and not very extensive, owing to the resistance offered to the knife by the cartilage. The thyroid body may be wounded and bleed freely, otherwise there is but little hæmorrhage. Blood may find its way into the trachea or lungs, and asphyxiate the patient. When the *trachea* is involved, the common carotid and inferior thyroid vessels are very liable to be wounded, giving rise to severe, if not fatal, hæmorrhage. Asphyxia may be brought about by displacement of the severed portions of the tube, or from the entrance of blood into the air-passages, whilst air may also be sucked into opened veins. The recurrent laryngeal nerve may be divided, causing paralysis of the larynx.

The **secondary effects** following cut throat are mainly inflammatory in origin. (*a*) Any form of *septic inflammation* may occur in the wound, possibly giving rise to cellulitis, which may spread downwards to the mediastinum. Where it involves the tissues above the entrance to the larynx, œdema of the glottis may be produced. Secondary hæmorrhage also arises from this cause, and even general pyæmia. (*b*) *Inflammation of the air-passages*, tracheitis, bronchitis, or broncho-pneumonia, frequently follows, partly as a result of the entrance of cold air, partly from the admission of septic material, such as food, decomposing blood-clot or discharges. The patient may become cyanosed from these causes, and in consequence of this partial asphyxia, the sensibility of the mucous membrane of the glottis is diminished, allowing of the passage into it of food which appears at the mouth of the wound; in some cases this may have arisen from division of the superior laryngeal nerve, but the depth at which this structure is situated in the neck makes it difficult to conceive how it could be divided without injury to the main vessels. (*c*) *Surgical emphysema*, or the entrance of the atmospheric air into the cellular tissue, may also follow a wound of the air-passages. It is not limited to the neck, but extends to the trunk, being recognised by the puffy distension of the part, and by a soft crackling crepitus elicited on pressure. It is of no great consequence, and usually disappears in a few days. (*d*) *Septic traumatic fever* is almost always present in these cases, the temperature varying with the extent of the inflammation in the cellular tissue or in the lungs.

The **Treatment** consists in securing all bleeding-points, if possible, but occasionally they are placed so deeply that it is necessary to tie the external carotid. General oozing from the surface must be attended to, for fear of blood being sucked into the air-passages; if it persists after thoroughly opening the wound and exposing it to the cold air, it must be checked by sponge pressure. Every attempt should be made to render the wound aseptic, and if there is a reasonable prospect that this has been attained, it may be closed by sutures in the ordinary way. Where, however, asepsis is doubtful, only the ends of the incision should be drawn together, the central portion being left open.

The treatment of the air-passages varies with the site of the lesion. If the trachea has been roughly divided, the portions should be steadied by a stitch on either side, and a tracheotomy-tube inserted—at any rate, for a few days; in some cases where cleanly cut, total closure without the use of a tube can be safely effected. When the wound involves the larynx, it is desirable to close the opening at once, since the larynx does not readily tolerate the presence of a tube; if it is necessary to introduce one, it is better to perform a high tracheotomy. When the wound involves the thyro-hyoid space, or is situated above the hyoid bone, it is quite safe in many cases to close the wound layer by layer after carefully disinfecting it. The mucous membrane is first dealt with by stitches which do not penetrate its whole thickness, and then a more thorough purification of the wound can be undertaken; if the epiglottis is divided, it must be accurately sutured. If there is any doubt as to the advisability of this proceeding, a high tracheotomy is first performed, and then the wound closed as far as possible.

In every instance the head should be flexed on the chest, and in suicidal cases a careful watch maintained to prevent the patient tearing the wound open. Extreme shock from loss of blood is dealt with by the infusion of saline solution, and the patient's general health attended to. Feeding should always be undertaken through a tube passed into the œsophagus, whether that structure is wounded or not, and such should be continued until the patient's natural powers of swallowing are restored.

The following **Sequelæ** occasionally result from a cut throat: (*a*) An *aërial fistula* is a persistent abnormal communication between the air-passages and the external air, and occurs most often in the thyro-hyoid space, the skin and mucous membrane being continuous one with the other around the margins of the opening. In some cases it may be closed; but if laryngeal stenosis or adhesions are present, it must be left alone for a time until these conditions have been treated. The operation consists in separating the skin from the mucous membrane, and in order to accomplish this, the external wound must be enlarged vertically. The edges of the mucous membrane are then pared, and stitched together horizontally. The external wound is either left open to allow of the escape of air and discharge, or may be partially closed, and a drainage-tube or gauze stuffing

Bronchocele or goitre, is a condition frequently seen i
and to which much attention has been directed of recen
to the discovery that the thyroid body exercises consider
over the metabolism and nutrition of the body. To
removal of the gland or its complete degeneration leads
tion of mucin in the body, producing myxœdema or
recently it has been suggested that the symptoms of Grav
due to the excessive absorption of normal or vitiated thy

The **Causes** of bronchocele are still enshrouded in
uncertainty. It occurs endemically in this and some o
being especially frequent in the hilly parts of D
Gloucestershire (and known, in fact, as Derbyshire ne
exceedingly common in Switzerland. The old idea
more frequently in places located on chalk or magnesia
not true, it being more common, perhaps, in regions w
sandstone and carboniferous limestone crop up. Possi
is due to the presence or absence of some mineral con
drinking-water, and the discovery made by Bauman
suggests that an absence of iodine is the cause of th
any rate, iodine is to be found in the normal thyroid sec
combination with albumen, whilst it is absent in cases
enlargement of the gland being looked on in the lig
pensatory hyperplasia. Other causes which have been
want of sunshine and air, as in the case of individua
valleys into which the air does not readily penetrate, o
ground kitchens and cellars of large towns, defective
ditions and the habit of carrying weights upon the hea
assisting. In the form ordinarily met with, it is not
any great extent, and is not influenced by intermarriag
be congenital, and if associated with skeletal chan
growth, and intellectual weakness, constituting the co

Varieties and Clinical Features.—Four chief forms of goitre are described, viz.: The parenchymatous or simple, the cystic, the fibro-adenomatous, and the exophthalmic; but the thyroid body may become enlarged in other ways, giving rise to the conditions known as malignant goitre and acute goitre, whilst acute inflammation is sometimes seen.

General Features.—In all these cases the thyroid body is the site of a swelling involving its whole substance, or one or other of its lobes, or possibly the isthmus alone. Its consistence varies with the nature of the growth, but it always moves with the larynx on deglutition. In every form there is probably a certain amount of

FIG. 330.—FRONT AND LATERAL VIEW OF A PARENCHYMATOUS GOITRE.

The right lobe had been removed by a former operation.

anæmia, whilst some of the symptoms characteristic of the exophthalmic variety are often produced even in simple cases, possibly from the excessive absorption of thyroid secretion. Pressure on surrounding structures leads to dyspnœa or dysphagia, and cerebral symptoms may arise from interference with the main vessels, which are displaced outwards. The trachea is especially liable to changes of situation and shape from its compression; it is usually flattened from side to side (*scabbard trachea*), and is sometimes pushed an inch or more from the middle line; atrophy of the cartilaginous rings may also be induced. If, as sometimes happens, the goitre develops downwards, pushing behind the sternum (*intrathoracic goitre*), the trachea is likely to be compressed from before backwards, and respiration may then be accompanied by stridor, but with no aphonia. Pressure

on the recurrent laryngeal nerve leads to harshness in speaking or aphonia, and to spasmodic attacks of dyspnœa, which may even prove fatal. It must be clearly understood, however, that the effects produced by a goitre are not necessarily proportionate to its size; some of the smaller growths at times produce severe symptoms.

Simple or Parenchymatous Goitre (Fig. 330) consists of a diffuse overgrowth of the whole thyroid body, the parts retaining to a great extent their usual proportions. The enlargement is due partly to an overgrowth of the glandular tissue, but also to an accumulation of colloid material within the vesicles; a normal amount of fibrous stroma is usually present. The whole gland is generally involved but possibly one lobe is larger than the other. It is soft and elastic

FIG. 331.—FIBRO-ADENOMA OF ISTHMUS OF THYROID BODY IN A WOMAN AGED TWENTY-THREE YEARS.

to the touch, quite painless, and there may be some amount of lobulation. Not uncommonly it is associated with a cystic development or new formation of an adenomatous type, and malignant disease is always preceded by this condition. When the interstitial tissue is abnormally abundant, as often occurs in the later stages, the tumour feels harder than usual, and is more definitely lobulated. It is then termed a *fibrous goitre*, and if the sclerosis is very marked, myxœdema may supervene.

The **Fibro-adenomatous Goitre** (Fig. 331) consists in the development of one or more encapsuled adenomatous nodules in the substance of the thyroid body, which is itself concurrently enlarged. These nodules are perhaps most common in the isthmus, but may occupy one or other lobe, or, when multiple, be scattered through the substance of the organ. If situated near the surface, their limitation and free mobility in the gland can be easily detected, but when placed

deeply their special features cannot be recognised. Two varieties have been described: (*a*) The fœtal, in which the growth is solid and homogeneous, consisting of closely apposed alveoli in which there is no colloid development, and identical in structure with embryonic thyroid tissue. Such growths are usually seen in young people; they are seldom very large, but frequently rather vascular. (*b*) The more ordinary type of adenoma resembles ordinary adult thyroid tissue more closely, and shows a considerable tendency to cyst formation. It is impossible to draw an exact line of separation between this latter condition and the simple hypertrophy, which is often of a diffuse adenomatous nature.

FIG. 332.—DIFFUSE FIBRO-ADENOMATOUS GOITRE. (KING'S COLLEGE HOSPITAL MUSEUM.)

Cystic Goitre (Cysto-adenoma) arises from the dilatation into cysts of alveolar spaces in the normal gland tissue or in a localized adenoma, the interalveolar walls being absorbed. They may be single or multiple, and contain either a thin fluid or a thick grumous colloid material, somewhat like furniture polish. Intracystic growths of a papillary nature are not unfrequent. The lining membrane of these cysts is epithelial in nature, the individual cells being cuboidal when the cyst is small, and flattened out or squamous when large. It is sometimes intensely vascular, and hæmorrhage into the cysts is by no means uncommon, causing the contents to be brown or blood-stained. Secondary changes occur in any of these varieties, chiefly affecting

the interstitial tissue, which may develop into cartilage or bone, or may calcify, but only in very chronic cases. Hæmorrhage into the alveolar spaces or cysts is not uncommon; acute infective inflammation may also involve the mass, and malignant disease, usually of a cancerous nature, sometimes supervenes.

As a rare complication may be mentioned general dissemination,* giving rise to secondary growths, which are usually found in the short and flat bones, especially the cranium and vertebræ, but occasionally in the viscera. Their texture is usually identical with normal thyroid tissue, but may be more cellular and of a cancerous type, and may be sufficiently vascular to pulsate. They produce local symptoms of varying gravity. The thyroid body may be apparently normal or the site of a simple goitre.

The **Treatment** of the three preceding forms of goitre may be considered together, as they are very different in nature to those which follow. In the early stages palliative measures can be employed, consisting in the improvement of the general health and the correction of errors in the personal and sanitary hygiene. Change of air to the seaside is often advisable, whilst iron and iodide of potassium may be administered internally, and iodine paint or iodide of potassium ointment applied locally. In India cures are often produced by inunction of iodide of mercury ointment, the part being subsequently exposed to the rays of the mid-day sun; such treatment is generally impracticable in this country. The deficient amount of iodide present in the gland in these cases explains why this drug is so pre-eminently useful, and it has been found that the active principle of the gland isolated by Baumann and called 'thyro-iodine' is the best form in which it can be administered. The exhibition of thyroid extract is sometimes followed by a diminution of a simple goitre, and the same explanation of its value probably holds good.

In cases where, in spite of such treatment, the growth persists or increases in size, other measures must necessarily be employed, and there is no doubt that removal of the tumour or of a part of the gland is the best practice to adopt. Total extirpation, as already mentioned, results in myxœdema; but as long as a sufficient portion of the secreting substance is left, whether it is derived from the isthmus or from one of the lobes, such accident need be feared. The operation necessitates a somewhat deep dissection, and will encroach on important structures; but with due care and the maintenance of efficient asepsis, the most satisfactory results are obtained, except when the growth is of very great dimensions. We would particularly emphasize the fact that goitres should be treated in the same way as other new growths, viz., by removal when small. There is still, unfortunately, a considerable tendency among practitioners and patients to leave them untouched until they are of large size, thus greatly increasing the risk of the operation. Other plans of treatment have been utilized in the past, *e.g.*, ligature of the thyroid vessels, division of the isthmus, curetting the mass with a lar-

* Patel, 'Tumeurs benignes du corps thyroïde donnant des metastases,' *Revue de Chirurgie*, 1904.

Volkmann's spoon, passage of a seton, or intraglandular injection of irritants, such as tincture of iodine; but they should be entirely discarded in favour of more radical measures.

Partial thyroidectomy (or Kocher's operation) is conducted as follows: An incision is made over the most prominent part of the tumour, preferably along the lower third of the anterior border of the sterno-mastoid. Kocher recommends a transverse or angular incision in order that the scar may be less visible, and this may be employed in suitable cases. The platysma and deep fascia are divided, the sterno-mastoid drawn outwards, and the sterno-hyoid, sterno-thyroid, and omo-hyoid displaced inwards, or, if need be, divided. The lobe to be removed is thus exposed within its capsule, which should not be opened. The limits of the mass are defined by the finger or a blunt dissector, and the vessels entering or leaving it are secured. The superior thyroid vessels are doubly ligatured and divided at the upper end of the growth, the middle thyroid vein is secured at the middle of its outer border, whilst the inferior thyroid vessels are dealt with below, special care being taken of the inferior or recurrent laryngeal nerve by tying the vessels as near to the gland as possible. The lobe is now freed from the underlying structures, as also the isthmus from the trachea. In detaching the latter, the surgeon must not forget that the cartilaginous rings may have been absorbed, and that the walls of the trachea, being then merely fibrous in nature, are easily wounded. The isthmus should be transfixed and tied in two halves with a silk ligature, so as to prevent hæmorrhage. The growth can now be removed, the bleeding-points secured, and the wound closed, the muscles and fascia being drawn together by buried stitches. A drainage-tube is best inserted for twenty-four or forty-eight hours, as it is difficult to employ much pressure on the neck, but this precaution may sometimes be omitted. Healing by first intention should be the invariable result.

Fibro-adenomata, when multiple or deeply placed, are treated by extirpation of the affected lobe; but if the new growth is single and superficial, its enucleation should be undertaken by the proceeding known as *Socin's operation*, which has been mainly popularized in this country by Mr. C. J. Symonds, of Guy's Hospital. The skin and muscles are divided as before, and the gland substance and capsule incised down to the growth, which is readily shelled out.

A single *cyst* is treated in the same way as a fibro-adenoma, viz., by enucleation; if several cysts are present, removal of the affected lobe may be necessary. The old line of practice, which is still occasionally utilized, consisted in tapping with a full-sized trocar and cannula, and injecting with tr. ferri perchlor. or iodine. Good results sometimes followed these measures, but occasionally the sudden relief of tension within the cyst gave rise to severe hæmorrhage from its walls, which threatened the patient's life. In such cases the cyst was laid freely open, and the cavity plugged with sponges or gauze soaked in some strong hæmostatic; or it was sometimes feasible to rapidly enucleate the whole cyst, and then command the hæmorrhage by ligaturing the supplying vessels.

Myxœdema (or cachexia strumipriva) is a curious condition, which, as already mentioned, supervenes when the thyroid body is totally removed, or so absolutely disorganized or infiltrated by a new growth as to be functionless. Although it is possible that we still have much to learn of the duties of this organ, yet we do know that the elimination, if not the development, of mucin in the body is controlled by it, and that its absence leads to an accumulation of this substance in the blood and tissues. The condition and appearance of the individual are very characteristic. The face is puffy, waxy white, and expressionless, with perhaps a hectic flush over the malar eminences; the tongue is enlarged; the limbs become thickened and clumsy by an increase in bulk of the soft tissues; there is often a puffy mass occupying the supra-clavicular fossa, which, however, does not pit on pressure. The mental faculties are dulled, and all intellectual processes are slow; the temperature is subnormal, and the heart's action weakened. Left to itself, death will supervene from asthenia sooner or later; should the case be treated by thyroid gland or extract (half a gland, raw or lightly cooked, twice a week, or a 5-grain tabloid once or twice a day), the symptoms soon disappear, and the change from the dull, heavy condition of myxœdema to one of normal health of mind and body is almost miraculous.

Similar treatment should be employed for myxœdematous cretins, who often start growing rapidly as soon as treatment commences.

Tetany is another condition which sometimes obtains after complete removal or disorganization of the thyroid body.

Exophthalmic Goitre, or, as it is often termed, Graves' or Basedow's disease, is a condition characterized by a diffuse enlargement of the thyroid body, which often pulsates forcibly owing to the dilatation of the vessels (particularly those in the capsule), associated with marked anæmia, severe palpitation and cardiac irritability (tachycardia), and protrusion of the eyeball (exophthalmos or proptosis). The nature of the disease has long been a topic of discussion, one of the earliest ideas being that it results from some derangement of the sympathetic nervous system, or possibly of the medulla. Lately, however, owing to the fact that in cases where thyroid extract has been given to excess symptoms somewhat akin to those seen in this condition have arisen, it has been suggested that the disease is due to the excessive absorption of thyroid secretion, although why it occurs in some cases of enlargement, and not in others, has not been explained. In all probability the truth lies half-way between the two theories, the enlarged thyroid and some of the symptoms being alike due to some central disturbance in the upper part of the medulla, whilst others are due to excessive absorption of thyroid secretion.

The patients usually affected are females, about the middle period of life, whose menstrual functions are often impaired. Overwork, worry, and severe mental strain, are apparently responsible for the onset of the symptoms in many instances, and a sudden shock or fright accounts for others. The protrusion of the eyeball is a marked feature of the case, and is sometimes due to an increase of the orbital fat. Contraction of the so-called muscle of Müller (unstriped muscular fibres stretched across the spheno-maxillary fissure) has also been suggested as a more plausible theory. When the patient looks down, the upper eyelid does not immediately follow the eyeball, allowing the white sclerotic to be seen between the lid and the cornea (von Graefe's sign). A fine fibrillary tremor of the limbs is also commonly observed in these cases. The patient is always extreme

nervous, and the pulse-rate high; any exertion or excitement increases the irritability of the heart's action, and may induce considerable respiratory distress. Left to itself, the disease in some cases tends to improve, but in others it may progress to a fatal issue from asthenia or cardiac complications.

Treatment consists in freeing the patient, if possible, from all sources of worry, whilst bromides, iron, and perhaps iodide of potassium, are administered internally, attention being also directed to correcting menstrual derangements, or any other abnormalities of function or structure; thus, the cure of a nasal catarrh by cauterizing the nasal mucosa has several times led to a rapid amelioration of the symptoms. Phosphate of soda has lately been much commended in this disease, and Kocher speaks favourably of it when conjoined with suitable hygienic measures. Thymus extract has also proved beneficial.

Since the introduction of the theory that the derangement is mainly thyroidal in origin, surgical treatment by removal of a portion of the gland has been suggested, and the results gained so far have been encouraging, although the proceeding is not devoid of serious risk, and should not be lightly undertaken. Half of the gland has usually been removed, but some surgeons have been satisfied with tying three of the thyroid arteries in order to starve the growth. General anæsthesia is decidedly dangerous in these cases, and it is better to rely on local anæsthesia, either of the Schleich type, or by cocainization of the superficial cervical nerve, which can be exposed at the posterior border of the sterno-mastoid at the level of the thyroid cartilage; 2 or 3 drops of a 2 per cent. solution should be introduced within its sheath. Patients are also very liable to syncope after the operation, and occasionally a curious train of symptoms supervenes within a few hours. The temperature rises suddenly to 104° or 105°, the pulse-rate is greatly accelerated, and the patient becomes delirious and finally comatose, dying in that state in about forty-eight hours. It is supposed that excessive thyroid toxæmia is responsible for these phenomena. The wound should be at once opened up, and probably a considerable quantity of a thin glairy fluid will be found within it. This should be soaked up by repeatedly packing the wound with dry sterile wool.

In the cases that recover, a gradual improvement usually shows itself, but the full benefit of the operation is rarely gained under six or twelve months, and even then the exophthalmos often persists. It is a little doubtful whether the improvement is really to be ascribed to the operation, or to the altered environment necessitated by it. The symptoms sometimes recur at a later date, and such cases have been treated by removing another portion of the gland.

Complete bilateral excision of the cervical chain of sympathetic ganglia has also been employed in this condition, and apparently with good effects; the mortality is decidedly less than in thyroidectomy.

Malignant Disease of the Thyroid Body is more frequently cancerous in nature than sarcomatous, usually taking the form of an adenoid

cancer, and always preceded by simple enlargement. The tumour grows rapidly, infiltrating the surrounding parts, and causing enlargement of the lymphatic glands, and secondary deposits in the viscera and elsewhere. The trachea is severely compressed, and in some cases perforated by the growth. The main vessels are frequently surrounded by the growth, and not merely displaced as in the simple variety. Myxœdema may ensue as a complication, owing to the total destruction of the glandular substance. Treatment by extirpation can only be undertaken in the early stages.

Acute Goitre is but rarely met with, consisting of a rapid enlargement of the thyroid body, which attains a considerable size in the course of a few days or weeks. It affects young subjects, and is generally fatal from asphyxia due to pressure on the trachea or spasm of the glottis. Comparatively little can be done for such cases; incisions into the fascia, division of the isthmus, and tracheotomy have been suggested. In the latter case it will be necessary to have a specially long tube, which can be passed for some distance down the trachea.

Inflammation of the Thyroid Body, or acute thyroiditis, occasionally supervenes as a complication of an ordinary goitre. It is almost always infective in nature, the cocci reaching it from without, as in a punctured wound, or from within the body on a pyæmic embolus, suppuration being usually induced; it sometimes follows a blow, and may then be simple. The gland becomes enlarged, hot and tender, fever and rigors follow, and the presence of pus is indicated by superficial œdema and fluctuation. The early **treatment** consists in the application of fomentations and perhaps leeches, or in the use of the ice compress. The patient is kept in bed, purged, and carefully dieted. Under such a régime, resolution may occur; but if, as happens more frequently, pus forms, free incisions should be made.

Accessory Thyroids sometimes develop above or below the isthmus or are closely attached to one of the lateral lobes. They are recognised by their connection with the thyroid body, moving up and down with it on deglutition, and if troublesome should be removed. They may also occur in any part of the thyro-glossal duct, and even in the base of the tongue, in that situation resembling a dermoid cyst.

CHAPTER XXXII.

SURGERY OF THE AIR-PASSAGES, LUNGS, AND CHEST.

Foreign Bodies in the Air-passages.

Any part of the respiratory tract may be partially or completely obstructed by the presence of some foreign body, the effect of which may be of greater or less gravity according to the situation, character, and size of the intruding substance.

1. **In the Nasal Passages,** see p. 831.

2. Obstruction occurring **at the Rima Glottidis,** or pharyngeal entrance to the larynx, is usually due to attempts to bolt large masses of food, which, becoming impacted, may cause immediate death. A person, eating a meal voraciously, turns black in the face and falls off his chair, dead. A similar result has followed such a foolish act as attempting to swallow a billiard ball. If the obstruction is not complete, as when a plate of false teeth becomes impacted, great dyspnœa is caused, and absolute inability to swallow, the symptoms rapidly increasing owing to œdema of the submucous tissue of the glottis. Accidents of a similar nature may occur during chloroform narcosis, an epileptic fit, or drunkenness, some such substance as a plate of teeth being dislodged from the mouth, or a mass of food being vomited, and blocking the entrance to the larynx. The **Treatment** must be very prompt, since there is no time to lose. The mouth should be forced open by the handle of a fork or anything suitable that happens to be near, and the finger rapidly swept round the pharynx so as to dislodge the foreign body. Failing this, laryngotomy must be performed at once, and artificial respiration, if necessary, instituted. In less urgent cases there is time to remove the substance from the mouth with the assistance of a frontal mirror.

3. **In the Larynx.**—A foreign body enters the larynx by inhalation during a deep inspiratory effort, when the glottis is widely open. Anything large is likely to be stopped above the larynx, and hence the type of foreign bodies we find in this region consists of small coins, buttons, nutshells, or a small tooth-plate. It may cause total obstruction and immediate death, or may enter one of the ventricles, and only produce partial obstruction, as evidenced by a sudden sense of suffocation, urgent dyspnœa, and a violent attack of coughing, attended perhaps by vomiting, such as occurs when anything is said to

at an angle on the end of a metal stem, which is inserted into the patient's widely-opened mouth in such a way that it rests against, and slightly elevates the soft palate. A beam of light is thrown into the mouth, either from an electric head-lamp on the surgeon's forehead, or reflected by a frontal mirror from a suitable source of illumination. The patient's tongue, held with a towel, is drawn well forwards so as to enable the light to reach the larynx, the image of which is seen in the mirror. Considerable practice is needed in order to attain any facility in the use of this instrument, as also to be able to recognise normal from abnormal structures. The use of cocaine to anæsthetize the fauces is in many cases indispensable. It must be remembered that the image is always inverted, so that the anterior portion of the larynx appears behind, but there is no reversal of the sides.

FIG. 333.—(EDEMA OF GLOTTIS FROM BEHIND (COLLEGE OF SURGEONS' MUSEUM.)

The base of the tongue is seen to be enlarged and swollen, and the aryteno-epiglottidean folds are œdematous, so that the entrance to the larynx is represented by a mere chink.

Acute and Chronic Laryngitis are conditions of but slight surgical interest. The acute affection arises from cold or over-exertion of the vocal apparatus, and is characterized by aphonia (loss of voice) and cough. Locally, the vocal cords are seen to be hyperæmic and swollen. The *Treatment* is rather medical than surgical, although in children intubation or tracheotomy may be sometimes required.

Diphtheritic Inflammation of the Larynx is usually met with as an extension of a similar affection of the fauces. It gives rise to severe dyspnœa from obstruction in the rima glottidis, and, if the condition does not yield to the injection of the diphtheritic antitoxin, will probably require intubation or tracheotomy.

Acute Œdematous Laryngitis, or œdema of the glottis, is a condition of considerable surgical importance. *Causes.*—(*a*) It is either secondary to some other laryngeal affection, such as acute catarrhal laryngitis, or acute perichrondritis; or (*b*) may extend from inflammatory conditions of neighbouring tissues, such as the root of the tongue, or the submaxillary region, *e.g.*, in cellulitis or Ludwig's angina; or it may be secondary to a retropharyngeal abscess. (*c*) It is also not unfrequently seen in children from drinking scalding water, as from the spout of a kettle, or sometimes in adults from swallowing corrosives. (*d*) It may result from the presence of a foreign body. *Characters.*—The folds of mucous membrane extending on either side of the epiglottis both to the root of the tongue and backwards to the arytenoid cartilages become swollen and œdematous from a serous effusion into the submucous tissue (Fig. 333). The same condition also involves the inter-arytenoid fold and the false vocal cords (superior thyro-arytenoid folds),

extending down as far as the true cords. The process is checked at this level owing to the absence of submucous tissue, the vocal cords consisting of elastic fibres merely covered with a layer or two of squamous epithelium. The epiglottis becomes folded laterally upon itself as a leaf, merely leaving a valve-like chink which permits of expiration, although considerably checking inspiration. The *Symptoms* produced by this condition are those of mechanical dyspnœa, to which, not unfrequently, spasm of the glottis is superadded, and this is sometimes of sufficient intensity to destroy the patient's life. There may be also some amount of febrile disturbance. The diagnosis is made, either by passing the finger into the pharynx, when the rigid, swollen epiglottis can be felt, or by laryngoscopic examination, when the slit-like opening of the glottis, bounded below and behind by thickened œdematous folds of mucous membrane, can be seen. *Treatment* consists in scarification of the swollen tissues below and behind the epiglottis, which can be effected after spraying the parts with cocaine either by the finger-nail or with a suitable knife guided by a laryngoscope. The usual result is a rapid diminution of the œdema, and additional relief may be gained by inhaling steam arising from hot water, to which some tinct. benzoini co. has been added. Fomentations or ice compresses applied externally are also

FIG. 334.—GUMMATOUS DISEASE OF THE LARYNX. (TILLMANNS.)

Small gummata are seen invading the mucous membrane of the epiglottis and front of the larynx.

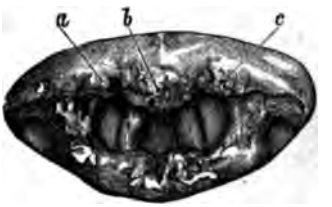

FIG. 335.—TUBERCULOUS DISEASE OF THE LARYNX, WITH EXTENSIVE ULCERATION IN FRONT AND BEHIND. (TILLMANNS.)

a, *b*, *c*, Remains of the epiglottis.

useful, especially the latter. In more severe cases, and especially in children, intubation may be necessary, or the air-passages may be opened below the obstruction, laryngotomy sufficing in adults, but a high tracheotomy being needed in children.

Syphilitic Disease of the Larynx.—In the *secondary* stage, mucous tubercles or superficial ulcers occasionally form in the neighbourhood of the vocal cords, concurrently with the rash on the skin, and the formation of condylomata and mucous tubercles elsewhere. These are most likely to occur in costermongers or those who have to speak loudly, and may then lead to a good deal of thickening of the cords. Apart from such cases, it rarely causes much trouble beyond a little hoarseness. No special treatment is required, although possibly the parts, if ulcerated, may be brushed over with a solution of perchloride of mercury. In the *tertiary* period, diffuse gummatous infiltration or localized gummata may develop, giving rise to destructive ulceration, which especially affects the epiglottis and aryteno-epiglottidean folds, and may spread backwards and involve the whole glottis (Fig. 334). Inflammation of the perichondrium is likely to follow, leading to necrosis of the cartilages. Hoarseness and dyspnœa are the chief symptoms of this affection, whilst considerable obstruction may be caused subsequently by cicatrization and laryngeal stenosis. *Treatment* consists in the administration of iodide of potassium and mercury, whilst ulcers may be sprayed with perchloride of mercury solution, or dusted over with calomel or iodoform. Should urgent dyspnœa arise, tracheotomy must be undertaken.

Tuberculous Laryngitis (Fig. 335) is occasionally a primary manifestation, but is much more frequently secondary to phthisis, arising from infection of the mucous membrane owing to the constant passage over it of the sputum. It

usually commences at the posterior part of the larynx in the neighbourhood of the arytenoid cartilages, as a submucous infiltration, which breaks down, and leads to typical tuberculous ulcers, similar to those occurring in other viscera (p. 164). Considerable destruction of tissue ensues, involving the whole circumference of the larynx, and even leading to necrosis and destruction of the cartilages. Hoarseness, cough, and perhaps a certain amount of dyspnœa, in a patient suffering from phthisis, are the chief symptoms arising from this affection, the prognosis of which is always of a grave nature. *Treatment.*—In phthisical patients local treatment is of but little avail, but where the disease is primary an attempt should be made to deal with it; such, however, can only be undertaken by the skilled laryngologist, as it consists in the topical application of caustics and antiseptics. Thyrotomy or subhyoid pharyngotomy has sometimes been practised, in order to attain this object more thoroughly.

Paralysis of the Larynx is observed in a variety of conditions, but is only of surgical interest when arising from injury or division of, or pressure upon, the recurrent laryngeal nerve. It may follow the removal of a goitrous tumour or of tuberculous glands, but is most commonly seen in connection with aneurisms of

FIG. 336.—PAPILLOMATA OF THE LARYNX, SPRINGING FROM THE RIGHT VOCAL CORD. (TILLMANNS.)

FIG. 337.—EPITHELIOMA OF THE LARYNX, INVOLVING THE RIGHT VOCAL CORD AND BASE OF THE EPIGLOTTIS. (TILLMANNS.)

the innominate or aorta, or tumours in the same neighbourhood, *e.g.*, cancer the œsophagus, the actual pressure in the latter case being probably exercis by secondarily enlarged lymphatic glands. Paralysis from the above causes generally unilateral, but if due to cancer both sides may be involved. The eff of complete paralysis of one recurrent laryngeal is to produce total immobility the affected side of the vocal cord, which lies in what is known as the 'cadav position'—*i.e.*, midway between that in which it is placed during phonation during inspiration. Not uncommonly the paralysis is incomplete, and merely affects the abductor muscle (the crico-arytenoideus posticus). *Symptoms* arising from unilateral recurrent paralysis are often slight, the v being usually but little modified, owing to the healthy cord being capabl passing across the middle line. If, however, both sides are completely paraly absolute aphonia, without dyspnœa, results; but if only the abductors are volved, the voice may be unimpaired, although severe dyspnœa is often pres and this may prove fatal unless tracheotomy is promptly performed.

Papilloma of the Larynx (Fig. 336) occurs in the form of wart-like mas usually growing from the true vocal cords, and giving rise to consider hoarseness and perhaps some dyspnœa. They are recognised on laryngosc examination, and may be removed successfully by laryngeal forceps, after parts have been efficiently cocainized. It is recommended by some author to destroy the growth with a galvano-cautery.

Epithelioma Laryngis occurs in patients over forty, originating as a papil overgrowth, usually near the base of the epiglottis, or from the true or f cords (Fig. 337). The tumour gradually spreads, both superficially and dee and may invade the cartilages, giving rise to necrosis. At a later stage it eate

beyond the limits of the larynx, attacking the base of the tongue, œsophagus, and even the lateral walls of the pharynx. As long as the disease is strictly limited to the larynx (intrinsic), the growth is often unilateral, causing hoarseness and aphonia, together with an irritable cough and the expectoration of blood-stained muco-pus, which may be horribly offensive; it is associated with but little tendency to affection of lymphatic glands. When, however, the growth has extended to surrounding structures (extrinsic), lymphatic enlargement follows, and the disease runs its usual course, destroying life by dyspnœa and exhaustion. Pain is often a most distressing symptom, being referred either to the larynx or pharynx, or, according to Ziemssen, not unfrequently to the ear.

Treatment.—In the early stages it is possible that thyrotomy and efficient curetting and cauterization may suffice to bring about a cure. Later on, removal of one or both halves of the larynx will be required, and the operation may even include parts of the tongue and pharyngeal wall. Where, however, the disease has spread extensively, its total extirpation is rarely practicable, and all that can be done is to treat symptoms as they arise, and perform tracheotomy when necessary.

Operations upon the Air-passages.

1. **Subhyoid Pharyngotomy** was devised by Malgaigne, in order to provide access to the upper parts of the larynx in the treatment of foreign bodies or tuberculous disease. A transverse incision is made through the thyro-hyoid space, the pharynx is opened, and the epiglottis detached from the base of the tongue (Fig. 338, I.). It is a proceeding that is seldom undertaken, and scarcely necessary.

A much more satisfactory procedure is **Trans-hyoid Pharyngotomy,*** in which the hyoid bone is divided in the middle line through a vertical incision extending from the symphysis menti to the thyroid cartilage.

The pharynx can then be opened either above or below the level of the hyoid bone, and the back of the tongue, the posterior wall of the pharynx, or the upper part of the larynx freely exposed. A preliminary tracheotomy is of course necessary. We have utilized this operation both for the removal of an epithelioma of the epiglottis and back of the tongue, and for enucleating a sarcoma of the posterior pharyngeal wall, and were much pleased with the approach given to these parts.

2. **Thyrotomy** (Fig. 338, II.) consists in a partial or complete vertical section of the thyroid cartilage, and may be required for the removal of foreign bodies or tumours, or for the radical treatment of laryngeal tuberculosis or cancer. Tracheotomy is performed as a preliminary measure, and the trachea plugged around the tube. An incision is then made in the middle line of the neck, extending from the hyoid bone to the cricoid cartilage. The crico-thyroid ligament is clearly defined and severed transversely, and the thyroid cartilage accurately divided by a knife, cutting-pliers, or fine saw. The lateral halves are separated, and the intra-laryngeal portion of the operation proceeded with. When closing the wound, the greatest care must be taken to bring the sides together in such a way that the vocal cords

* See *Revue de Chirurgie*, May, 1900.

are exactly opposite each other, or phonation will be considerably impaired. This is best ensured by making a horizontal cut across the front of the cartilage before dividing it.

3. **Extirpation of the Larynx (Laryngectomy)** is always a serious operation, which is never undertaken except for malignant disease. According to the site of the tumour the removal may be partial or complete for a growth strictly limited to one side, extirpation of that half will suffice, and admirable results have followed such treatment, distinct speech remaining; but if the whole larynx is removed, although the patient is subsequently able to whisper, phonation is impossible without mechanical assistance, whilst if the disease has extended beyond the limits of the larynx, operative interference is very unsatisfactory.

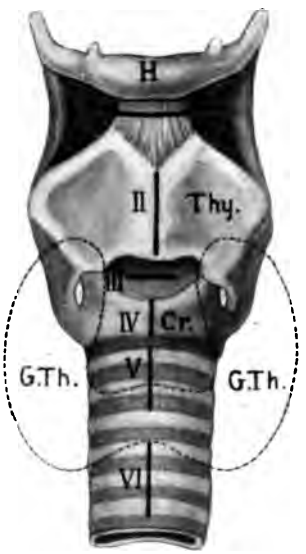

FIG. 338.—OPERATIONS ON THE AIR-PASSAGES.

I. Subhyoid pharyngotomy; II., thyrotomy; III., laryngotomy; IV., cricotomy; V., high tracheotomy; VI., low tracheotomy; H., hyoid bone; Thy., thyroid cartilage; Cr., cricoid; G.Th., thyroid body.

Operation for Complete Extirpation.—A low tracheotomy should be performed, as a preliminary measure, and preferably a few days before; the trachea is plugged with a Hahn's tube or a Trendelenburg's air tampon at the commencement of the operation. An incision is made in the middle line of the neck from the hyoid bone to below the cricoid cartilage, at the upper end of which a transverse cut is made, extending as far as the sterno-mastoid muscle on either side. The soft parts are then stripped from the lateral borders of the thyroid cartilage with raspatories, the sterno-hyoid, sterno-thyroid, and thyro-hyoid muscles being divided at their insertions. Both the superior and inferior laryngeal vessels are tied and divided. Having thus freed the larynx anteriorly, the subsequent steps of the operation may be undertaken either from below upwards or from above downwards; the former proceeding is, to our minds, the better. The crico-tracheal membrane is divided, and the larynx drawn forwards, so as to enable the posterior attachments, *i.e.*, the connections of the constrictor muscles to the cricoid and thyroid cartilages, to be severed by scissors, the larynx being thus separated from the anterior pharyngeal wall, which must be left intact, if possible. The thyro-hyoid membrane and the base of the epiglottis are cut through, and the final steps of the operation consist in clearing the superior cornua of the thyroid, and dividing the lateral thyro-hyoid ligaments. The

operation is not particularly difficult or dangerous, provided that the surgeon keeps close to the larynx, and that the disease does not spread beyond its limits. When other structures, such as the base of the tongue, have been invaded by the growth, these steps must be modified so as to secure, if possible, complete removal of the disease. Finally, the transverse incision is sutured, but no stitches are inserted in the median wound, which is plugged, and allowed to heal by granulation. The upper end of the trachea should be secured to the skin at the lower angle of the wound, so as to prevent its retraction. The patient is fed *per rectum* for a few days, or by the passage of an œsophageal tube. At the end of a week the tracheotomy-tube is removed from its original situation, and inserted into the upper end of the trachea, the lower opening being allowed to close. When the wound has healed sufficiently, an artificial larynx can be inserted, by means of which the patient is able to speak in a somewhat reedy monotone, but it is seldom satisfactory.

Dr. H. Lambert Lack advocates the total closure of all communication between the pharynx and the air-passages after laryngectomy. The upper end of the trachea is securely stitched all round in the lower angle of the incision and flush with the surface. The rent in the mucous membrane of the pharynx is then carefully closed; the wound is thoroughly disinfected, and the various layers of muscles are sutured together, as also the skin. Union by first intention can thus be attained, and the results have been most gratifying. Phonation is of course lost absolutely, but the patient can whisper, the necessary air-pressure being obtained in the dilated pharynx or upper end of the œsophagus.

If the disease is limited to one half of the larynx, the thyroid cartilage is cleft in the middle line, and the operation confined to the affected side.

4. **Laryngotomy** is never undertaken but for the relief of dyspnœa arising from some *sudden* obstruction to the respiration, and is thus to be looked on as an operation of urgency. It is required in cases where the entrance to the larynx is obstructed by a foreign body, for spasm of the glottis, or for accumulations of blood in the neighbourhood of the larynx during an operation. It is readily performed by making a vertical incision over the situation of the crico-thyroid membrane, which is then divided transversely along the upper border of the cricoid cartilage (Fig. 338, III.), the sterno-hyoid muscles being, if necessary, drawn aside, and a tube inserted. Possibly the small crico-thyroid artery arising from the superior thyroid may require a ligature. In cases of great urgency, a simple transverse incision may be made with a penknife, and the larynx opened, the margins of the wound being held aside by a hairpin, or by the handle of a scalpel turned edgeways, whilst a toothpick will serve temporarily as a cannula. Whenever there is time to operate deliberately, a high tracheotomy is the better practice, since a tube inserted through the crico-thyroid space gives rise to considerable irritation, and the voice may be subsequently impaired by the contraction of the cicatrix. A

special laryngotomy-tube is required, the lumen of which is oval and flattened from above downwards, not circular.

In children, where there is but little space, the proceeding may be modified by division of the cricoid cartilage, and even of the first ring of the trachea, constituting what is known as *cricotomy* or *laryngo-tracheotomy* (Fig. 338, IV.).

5. **Tracheotomy.**—The trachea usually consists of from sixteen to twenty rings, of which six or seven are situated above the sternum. The isthmus of the thyroid body usually covers the third and fourth rings, and the trachea may be opened either above or below it, or even sometimes behind, the isthmus being, if necessary, divided. Tracheotomy is required in any condition in which there is serious obstruction to the respiration, *e.g.*, various forms of laryngitis, and especially that due to diphtheria; for stenosis, tumours, and some forms of paralysis of the larynx; for the removal of foreign bodies, either in the larynx, trachea, or one of the bronchi; or for compression of the larynx or trachea by external tumours, such as an enlarged thyroid body. It is also undertaken as a preliminary measure in operations on the mouth, tongue, pharynx, or larynx, in which there is any likelihood of asphyxia or secondary septic pneumonia, owing to the entrance of blood or septic discharges into the air-passages. As a general rule, the high operation (that is, above the isthmus of the thyroid body) is to be preferred, but under special circumstances it may be advisable to open the trachea lower down. The risk attaching to the high operation is considerably less than to the low, but the opening is made nearer to any disease which may exist in the larynx. For the removal of foreign bodies from the bronchi or trachea, the low operation should always be employed.

The *high* operation (Fig. 338, V.) is performed as follows: The patient is placed on the back, with a sandbag or pillow beneath the neck, so as to throw the head backwards and put the structures on the stretch, and with the shoulders somewhat raised. Anæsthesia may be induced by chloroform, but it is unnecessary, and indeed unwise, to push the anæsthetic, since it is only needed for the division of the skin; where the dyspnœa is considerable, it is better to employ cocaine. The head is held exactly in the middle line, and the surgeon feels for, and identifies, the cricoid cartilage. The incision extends from this structure downwards for about 1½ inches. The superficial fascia is divided, and the interval between the sterno-hyoid muscles made out, so as to enable them to be separated one from the other. The edges of the wound are drawn aside by blunt hooks, which should both be held by one assistant, so as to ensure equable traction.

The isthmus of the thyroid body may now be seen, and, if projecting unduly upwards, should be pushed down after the fascia along its upper border has been transversely incised. The trachea is next clearly exposed by using the handle of a scalpel and dissecting forceps, and should be fixed and steadied by inserting a sharp hook into the lower border of the cricoid cartilage. The wound is freed

from blood as far as possible, and the trachea opened by inserting the point of the scalpel and dividing two of the rings from below upwards. A deep inspiration is usually taken at once, followed by a severe fit of coughing, and if the operation is undertaken for diphtheria the surgeon must be careful not to let any membrane which may then be expelled enter his eyes, nose, or mouth. The insertion of the tube is in many cases easy, in others a matter of some difficulty; a good deal depends upon the age of the patient, the urgency of the symptoms, and the depth from the surface at which the trachea lies. Anything which suffices to separate the lips of the tracheal incision, *e.g.*, the handle of a scalpel introduced and turned, a couple of hooks, or dressing forceps, will form an efficient guide for this purpose. The breathing soon becomes quiet and regular, and the tube is fixed in position by tapes passed through lateral openings in the face-

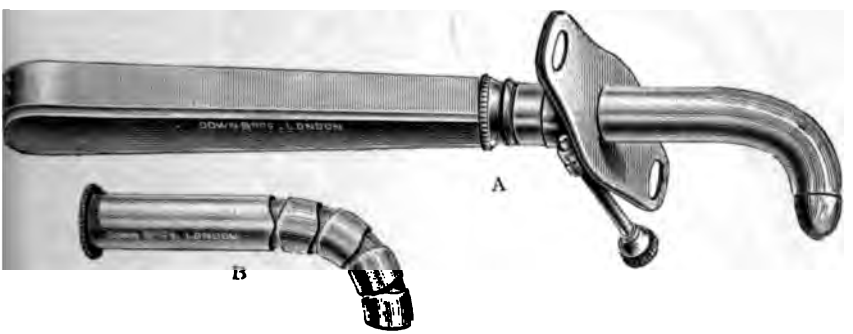

FIG. 339.—DURHAM'S TRACHEOTOMY-TUBE. (DOWN BROTHERS.)

A, Outer tube with introducer; B, lobster-tailed inner tube.

plate, and tied round the neck. No dressing is required for the wound except a few layers of gauze beneath the plate.

Low tracheotomy (Fig. 338, VI.) is performed in almost precisely the same way, except that the incision extends farther downwards, even reaching to the episternal notch, although the deeper part of the wound should never pass beyond a finger's breadth above the sternum, for fear of opening that portion of the cervical fascia which is prolonged downwards to the pericardium, or of wounding the left innominate vein. The superficial layers of fascia are divided, and the sterno-hyoid and sterno-thyroid muscles drawn to either side by retractors. The inferior thyroid veins then come into view, and may cause trouble if they are distended with blood, as is so frequently the case in patients suffering from dyspnœa. They must be held aside by hooks, or divided between ligatures, and the deep layer of fascia behind them incised so as to expose the trachea, which is cleared, fixed, and opened in the same way as described above.

Many different forms of *tracheotomy-tube* have been used from time to time, but that most generally employed consists of a double

cannula, the inner portion of which can be readily removed and cleansed; it should always be longer than the outer, in order to prevent any plug of mucus being left within the outer tube on removal of the inner. A face-plate, or some similar contrivance, is attached to the outer cannula, in order to fix and steady it. One of the best is that known as *Durham's lobster-tailed tracheotomy-tube* (Fig. 339, A and B); the rigid outer tube of this instrument is introduced by means of a flexible guide set on a handle, and passed within it. The guide is then withdrawn, and replaced by the inner flexible cannula (B). *Parker's tube* (Fig. 340) also has a handy introducer, and is perhaps of a better shape than most of the others, following more closely the direction of the trachea. The *bivalve tube* is another useful instrument; the outer sheath consists of two lateral portions, attached to a single face-plate, and these can be pressed together, and hence with care easily inserted through the incision in the trachea. The surgeon must see that both limbs enter the trachea, as trouble has arisen from one limb passing outside, and the other inside, thus hindering the introduction of the inner tube. In cases of preliminary tracheotomy (p. 854), undertaken to prevent the entrance of blood during operations, *Hahn's tube* may be used with advantage; in this the outer cannula is covered with a layer of compressed sponge which swells up from the absorption of moisture, and thus occludes the lumen of the trachea. *Trendelenburg's tampon* is recommended by some for the same object; the outer tube is here ensheathed with a thin indiarubber casing, which can be distended with air at will.

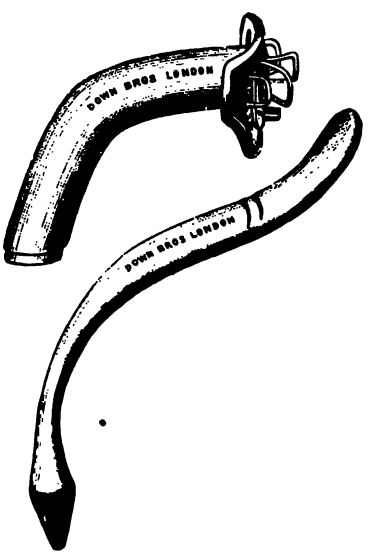

FIG. 340.—PARKER'S TRACHEOTOMY-TUBE AND INTRODUCER. (DOWN BROTHERS.)

Difficulties and Dangers of the Operation.—Although the above description might lead the student to suppose that tracheotomy is an easy operation, this is by no means always the case, partly owing to the fact that it frequently has to be undertaken in a hurry, with perhaps inefficient assistance, and in a bad light, and partly owing to the intense vascular engorgement of the structures met with. A cool head and a steady hand are in such cases of infinitely more value to the operator than the most perfect anatomical knowledge. The following are the chief conditions which may lead to mistakes and accidents:

(1) The administration of any general anæsthetic is often inadvisable in semi-asphyxiated patients, since complete *cessation of respiration* may be caused thereby, possibly from spasm of the glottis. In such local anæsthesia must be relied on, and the employment of β-eucaine and adrenalin, as described in Chapter XLIV., has been most satisfactory.

(2) It is *not always easy to find the trachea*, especially in the necks of fat children, or where it is hidden by an unduly large thyroid isthmus, or possibly by the projection of the thymus gland into the neck. It is here most essential to remember the old adage, *In medio tutissimus ibis*, although occasionally the trachea may be displaced from the middle line by some external growth, and can then only be found by careful exploration with the finger.

(3) *Hæmorrhage* is generally troublesome. It is usually venous in character, arising either from the anterior jugular vein or from the inferior thyroid plexus. If possible, it should be controlled by pressure-forceps before opening the trachea; but this is not absolutely necessary in urgent cases, since it usually ceases as soon as easy respiration through the tube has been established. The presence of the left innominate vein in front of the trachea must not be forgotten, although it but rarely reaches above the sternum. In about 8 per cent. of all subjects an arterial twig (the *thyroidea ima*) courses upwards from the innominate artery along the trachea, to reach the isthmus of the thyroid body; if divided, it can be easily secured and tied. Should much blood be inspired, it may determine the occurrence of septic pneumonia at a later date.

(4) The possibility of the *entrance of air into veins* must not be overlooked, although it is an uncommon accident, since the intravenous pressure is so great.

(5) Not unfrequently considerable mischief has been done by an *incautious use of the knife*, especially if the operator forgets to fix the trachea with a sharp hook before opening it. In a child the trachea is small; and if it is moving rapidly up and down, as happens in urgent dyspnœa, or if the child is restless, and not completely under the influence of an anæsthetic, the difficulty is manifestly increased. Many accidents have happened from this cause, *e.g.*, wounds of the large veins or arteries of the neck, or even of the œsophagus or bodies of the vertebræ!

(6) As soon as the trachea is opened, a severe fit of *coughing* is induced, which is sometimes so prolonged as to interfere with the introduction of the tube. Under such circumstances the incision in the trachea may be opened up with a tracheal dilator, or by a pair of sinus forceps, and a few drops of cocaine swabbed over the mucous membrane.

(7) The *introduction of the tube* is a matter of no difficulty if the surgeon takes the precaution of not removing the hook until this is satisfactorily accomplished. Many mistakes have followed the non-observance of this rule; thus, the tube has missed the trachea altogether and passed into the fascial interspace in front, as also to one

or other side; as before mentioned, the outer portion of a bivalve tub has often been passed with one limb within the trachea and the othe outside. A very dense diphtheritic membrane has also been a caus of difficulty, in that, although the tube has been really passed int the trachea, it has not penetrated the membrane, and thus ha hindered rather than helped the breathing. In all cases of diphtheri the trachea should be freely opened, and the interior carefull examined by separating the lips of the incision before attempting t insert the tube. In order to prevent the downward passage of th membrane, some surgeons have recommended that the lower portio of the larynx should be carefully stuffed with antiseptic gauze abov the tube.

After-Treatment.—The patient is placed in bed, in a room kept a a uniformly warm temperature (75° F.), the air being moistene by the steam issuing from one or more bronchitis kettles, so as t make up for the absence of nasal and oral respiration. Draught are excluded by curtains, and nothing should be placed over th entrance to the tube, so that respiration may not be hindered, nor th expectoration of mucus, false membrane, etc., prevented. One o the most frequent sources of extension of diphtheria to the lungs, o of septic pneumonia, is the re-inspiration of material which has bee coughed out upon a portion of muslin or gauze, placed with excellen intentions over the mouth of the tube. A nurse should be in constan attendance on the patient, in order to wipe away all such materia *as it is expelled.*

The inner portion of the tube is removed by the nurse, and cleane two or three times a day, any inspissated mucus upon it being readi removed by the use of a solution of bicarbonate of soda (20 grai to 1 ounce). The outer tube is also removed once a day for cleansi purposes, but only by the medical attendant. Should the respirat become impeded by a collection of mucus in the trachea, a f feather may be passed down the tube in order to clear it, but *new diphtheritic cases;* for such a contingency special suction-tubes h been devised. Attempts have been made to clear the passage applying the lips to the tube, and removing the block by suct such is, however, quite unjustifiable, and several promising h surgeons have in this way lost their lives.

The period for which the tracheotomy-tube is kept in po varies in different cases, but its removal should always be under at as early a date as possible, for fear of leading to impairm the voice. In order to prevent this, the inner cannula is mad a hole in the upper end, so that part of the air may pass throu larynx. If the patient can then breathe comfortably when th is placed over the entrance to the tube, its presence is no necessary.

After-complications of Tracheotomy.—(*a*) The tube may giv ulceration of the trachea if it is not correctly shaped. Tht much curved, it tends to irritate the anterior wall, and c known in which it has caused death by perforation of

innominate vein. If insufficiently curved, the posterior wall may become affected, and the œsophagus laid open. In cases where a tracheotomy-tube has to be worn for a long time, it is advisable to make use of indiarubber tubes.

(*b*) Various forms of septic trouble may arise in the wound, leading to cellulitis and even secondary hæmorrhage; this is especially dangerous in the low operation, since the inflammation may extend to the mediastinal tissues. In cases of diphtheria the wound may also become affected with the disease.

(*c*) Inflammation of the trachea, bronchi, and lungs may result either from the entrance of cold, or unmoistened air, or from the inspiration of septic or diphtheritic material.

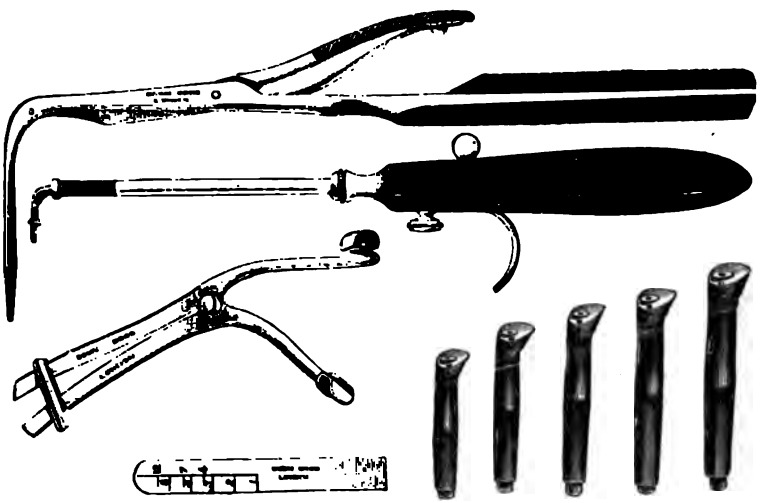

FIG. 341.—O'DWYER'S INTUBATION APPARATUS. (DOWN BROTHERS.)

The cannulæ are seen below on the right; a hinged inner tube passes throughout the length of each, and the upper end of this is screwed to the extremity of the introducer seen in the middle; when it has been inserted into the larynx, the trigger of the introducer is drawn, and by this means the inner tube is loosened and can be easily removed, leaving the cannula in position. To extract the tube, the rectangular forceps represented at the top is utilized; the point of the forceps is inserted into the top of the cannula, and then by opening the blades the cannula is fixed and can be withdrawn. A useful type of unilateral gag is also represented, and a small gauge to indicate the size of cannula required at different ages.

(*d*) Difficulty is sometimes experienced in leaving off the tube, owing to the presence of granulations obstructing the lumen of the trachea, or to stenosis of the larynx from contractions or adhesions of the vocal cords, or even to paralysis of the abductor muscles, especially in diphtheritic cases. The trachea may also be kinked, and its calibre thus diminished, by cicatricial union of the skin and mucous membrane. The diagnosis of the cause at work in any

particular case can only be made by laryngoscopy, or careful examination of the wound and upper portion of the trachea. Granulations may be scraped away under an anæsthetic or destroyed by caustics; stenosis of the larynx is overcome by dilatation with an O'Dwyer's tube, whilst laryngeal paralysis must be treated by the use of electricity.

6. **Intubation of the Larynx** is a means of treating laryngeal obstruction which has been introduced in order to obviate the risk always present in tracheotomy. It consists in the passage through the mouth of a suitably curved tube into the larynx, by means of a specially contrived introducer. The best patterns to employ for the purpose are those known as O'Dwyer's tubes (Fig. 341). The lower end of the cannula is oval, and not circular, and passes between the cords into the larynx, whilst the upper enlarged end lies over the entrance; it requires changing frequently in order to prevent erosion of the mucous membrane. It has been used with considerable success in cases of œdema of the glottis and laryngeal stenosis, but is scarcely to be recommended for diphtheria, owing to the risk of carrying the false membrane down with it.

Affections of the Ribs and Sternum.

Several forms of **Fracture** have been already described (pp. 482 and 484).

Acute Suppurative Inflammation of these bones is very unusual. Occasionally an acute osteo-myelitis, running its usual course to necrosis, occurs in children; but the most common cause is typhoid fever (p. 582). The affection is generally of a subacute type, and a more or less extensive cario-necrosis results. The special feature of the disease is the tendency of the bacilli to remain in a latent condition in the tissues, so that it is difficult to ensure a perfect cure apart from complete extirpation of the affected portion of bone. Mere scraping is rarely sufficient.

Syphilitic Disease is more common in the sternum than in the rib. The upper part of the *sternum* is that usually involved, and the affection is characterized by a formation of gummata in and upon the bone, which erode it, usually in a pitted fashion, and may cause necrosis. The usual treatment with iodide of potassium and mercury is required, and sequestra will need to be removed. In connection with the *ribs*, syphilis appears as a tertiary periostitis or perichondritis. A fusiform swelling is produced in the course of a few weeks, with but little pain or tenderness; it may easily be mistaken for tubercular disease or a new growth, but the history of the patient may help to a correct diagnosis, or the administration of iodide of potassium will clear it up.

Tuberculous Disease affects the ribs much more frequently than the sternum. In the *ribs*, tubercle may arise primarily as a periostitis or more often as an osteo-myelitis, implicating the medulla for some distance, but the disease is not unfrequently secondary to tubercle

neighbouring parts, *e.g.*, the spine or pleura. Several foci may occur in a single rib, or several ribs may be involved at the same time. The disease is most commonly seen in young people, and affects either the back of the rib, not far from its vertebral attachment, or the costo-chondral junction. The usual manifestations of tubercle in bone are seen, giving rise to caries or necrosis, and suppuration is common. The abscess cavity may be mainly external to the ribs, but is not unfrequently hour-glass shaped, a narrow neck connecting the cavities which lie inside and outside the chest. *Treatment* in these cases must be of a radical type. Mere scraping and disinfection are often inefficient, and the complete dissection of an extensive portion of the rib and of the abscess cavity attached to it is required.

In the *sternum* tubercle runs its usual course, and may present an abscess which points either in front near the middle line, or may come forwards from behind through an intercostal space. The treatment consists in cutting or scraping away the abscess wall, and in dealing with the bone; it may be necessary to remove some portion of it by gouge or cutting-pliers in order to gain access to the primary process.

Tumours of the ribs and sternum are usually chondromata or chondro-sarcomata; perhaps the former are a little more common in the ribs, the latter in the sternum. The patient complains of but little pain, and therefore the cases are usually late in coming under observation. Adhesions form externally to the pleura, and the lung itself may be invaded. In the early stages it is sometimes possible to remove them, although the lung is likely to collapse in the course of such a procedure.

Surgical Affections of the Lungs and Pleural Cavities.

Wounds of the Lungs result from violence applied to the chest, with or without fractures of the ribs, or in consequence of penetrating injuries.

Non-penetrating Wounds consist either of laceration or contusion.

Contusion of the lung often follows some injury which is not sufficiently severe to fracture the ribs. The symptoms produced are severe pain in the side, with perhaps temporary shock and slight haemoptysis. Some traumatic inflammation follows, both of the lung and of the pleura, as indicated by loss of resonance and possibly friction sounds. The treatment consists in keeping the patient quiet in a warm room, at the same time carefully regulating the bodily functions. Pain is often relieved by strapping the side of the chest.

Laceration of the lung is usually secondary to fracture of the ribs, especially from direct violence. The severity of the symptoms necessarily varies with the character and extent of the injury. The patient suffers from marked shock in severe cases, associated with pain in the side and dyspnœa. Evidences of *hæmorrhage* soon follow, either in the form of hæmoptysis or hæmothorax. If the wound is a

small one, the patient complains of an irritating cough, and brings up a good deal of blood-stained frothy mucus; but if the laceration is extensive, involving some of the larger pulmonary trunks, a quantity of pure blood may be ejected, even leading to death from syncope, or from asphyxia, owing to the blood filling the larger bronchial tubes. *Hæmothorax* may also be so excessive as to cause the patient's death from compression of the lung. It results in a gradually increasing area of dulness extending from below upwards, together with loss of breath-sounds and vocal fremitus, coming on soon after the injury without signs of inflammation.

Owing to the laceration of the pulmonary vesicles, air tends to escape either into the pleural cavity, giving rise to the condition known as pneumothorax, or into the cellular tissue of the body, constituting surgical emphysema. *Pneumothorax* is always associated with more or less collapse of the lung, and is almost certain to lead to considerable interference with respiration, and possibly to severe dyspnœa, or even orthopnœa. The air which finds its way into the pleura, having been filtered through the lungs, is free from organisms, and hence does not cause suppuration or putrefaction of the blood-clot present, unless bronchitis or some other suppurative condition has existed previously. The physical signs of pneumothorax consist in a high-pitched tympanitic note on percussion, and on auscultation amphoric breathing and possibly metallic tinkling. As soon as the wound in the lung commences to heal, the amphoric sounds disappear, the effused air is absorbed, and the lung gradually expands—a process which may take four or five days. If blood is also present in the thorax, a condition of hæmopneumothorax is produced, recognised by a splashing or succussion sound heard on shaking the patient. *Surgical Emphysema* almost always indicates a wound of both pulmonary and parietal layers of the pleura, which are slightly separated by air, constituting a localized pneumothorax. At each inspiration a fresh amount of air enters this cavity, and is expelled into the areolar tissues through the parietal wound at each expiration, being forced perhaps to a considerable distance from the spot where it commences, or even spreading over the whole body. It is of no serious significance, disappearing rapidly after the wound in the lung has commenced to heal, thus occluding the opened pulmonary alveoli. It is recognised by the parts becoming swollen and puffy, and giving a sensation of fine crackling crepitus when the hand is pressed over them. Occasionally emphysema may arise as an *interstitial* condition, when the parietal pleura has not been injured, the air escaping from the alveoli along the inter-alveolar connective tissue into the root of the lung, and then appearing first at the lower part of the neck.

Such are the ordinary phenomena observed in the early stages of a ruptured lung. The effects subsequently produced consist in a localized traumatic pleuro-pneumonia, associated with slight elevation of the temperature, possibly rusty sputum, and often severe dyspnœa. In the worst cases death may result from asphyxia.

Penetrating Wounds of the Lung are followed by very similar

effects, modified, however, by the fact that the external wound in the chest wall allows of the exit of blood, arising either from an intercostal artery, the internal mammary, or from the wounded lung, whilst it also permits the entrance of septic organisms with the air into the pleural cavity, and thus may change the character of the resulting pleuro-pneumonia from a simple to an infective inflammation. Empyema is consequently a frequent sequela, whilst the inflammation of the lung may be of a spreading nature, possibly terminating in suppuration or gangrene. Surgical emphysema is also induced by air being sucked into the wound during inspiration, and failing to escape during expiration, owing to the lips of the wound falling together. This condition may ensue even when the lung itself has not been damaged.

Treatment.—When the rupture of the lung is due to a subcutaneous injury, the patient should be kept quiet in a warm room, and the side strapped. The compression of the chest wall must sometimes be omitted in patients where the irregular ends of fractured ribs, broken by direct violence, are driven inwards, for fear of increasing the mischief in the lung.

Persistent hæmoptysis must be treated by keeping the patient absolutely quiet, and allowing him to suck ice continually. Ergotin may be injected hypodermically, or a mixture of ergot, opium, and sulphuric acid administered; the opium is especially needed when great restlessness and irritability are present. Stimulants are necessarily contra-indicated, for fear of again starting the bleeding. Hæmothorax rarely needs special treatment, since the blood soon clots and is readily absorbed; but occasionally it may be so abundant as to compress the lung and lead to dyspnœa, and under these circumstances it may be necessary to open up the pleural cavity and remove it. Such must never be undertaken until sufficient time has elapsed to permit of thrombosis in the wounded vessels. Decomposition of the blood in the pleural cavity occasionally happens even in non-penetrating injuries, the bacteria reaching it either from the blood or from the lacerated bronchi; the suppuration and fever thereby induced necessitate the opening and drainage of the pleural sac.

Simple pneumothorax seldom requires surgical treatment, since the imprisoned air is quickly absorbed, and the lung re-expands; should this not occur, and if severe dyspnœa is present, it may be advisable to remove the air by aspiration. This may sometimes fail or the air may re-collect, and then the chest wall must be opened so as to give exit to the air. It is impossible for the lung to re-expand against the pressure of air confined in the chest; when an opening is made, the air can be driven out by a vigorous expiratory movement, such as coughing, which also forces air from the healthy lung into the wounded one when the glottis is closed.

Temporary dyspnœa may be overcome by the inhalation of oxygen; but when of a more decided character, and not due to any condition which can be removed, the essential treatment is to diminish the blood-pressure, and thus decrease the amount of blood carried to the

uninjured lung, so as to enable it to cope with the work of blood-aëration. This may be accomplished by administering antimonial wine (10 to 15 minims every four or six hours) combined with full doses of liquor ammoniæ acetatis; but in urgent cases, where the patient is becoming cyanosed, and life is threatened by asphyxia, venesection must be adopted. The blood is withdrawn from the arm rapidly and freely, and as it flows the dyspnœa passes off. This may be repeated once or twice in addition to the use of the medicine before the full effect is obtained and respiration becomes unembarrassed.

The treatment of *penetrating wounds of the thorax*, involving the lung, is always a matter of considerable difficulty. The skin around the opening is carefully purified and shaved, if necessary, and a limited exploration of the wound is permissible, so as to determine whether portions of the clothing have been carried in, or a rib comminuted; all such loose fragments must be removed, as also any penetrating foreign body, such as a bullet, if readily accessible. The greatest gentleness must, however, be employed, and no attempt made to pass a probe into the pleural cavity, since it is easy to dislodge clots lying in the pulmonary tissues, and thereby restart the bleeding. If the wound itself needs sterilizing, it is perhaps best to touch it over with pure carbolic acid rather than to irrigate it, and then a dry antiseptic dressing is applied without drainage.

Immediate operative interference is only required under two conditions, viz., for hæmorrhage and for hernia of the lung.

Hæmorrhage after a penetrating wound of the chest wall may be derived either from a vessel in the parietes (intercostal or internal mammary) or from the lung itself. The recognition of the source of the bleeding is not always easy, but it is probably of *parietal* origin (*a*) if it is unaccompanied by hæmoptysis; (*b*) if it increases obviously at each systole; and (*c*) if it can be controlled by digital compression. The treatment of bleeding from the internal mammary and intercostal vessels has been already indicated (p. 291).

Pulmonary hæmorrhage is not so readily controlled, and various plans have been recommended. Probably the best method consists in keeping the patient absolutely quiet in the horizontal position, applying cold to the side, and giving hæmostatics, as indicated above for non-penetrating wounds. The effect of this will be to cause the blood in the pleural cavity to clot, and this acts as a tampon to the affected viscus; firmly plugging the external wound may limit the loss of blood and determine coagulation more quickly. In bad cases the hæmorrhage may cease only when the patient is in a condition of profound collapse; intravenous or hypodermic infusion of hot saline solution may then suffice to tide over the period of danger and lead to a successful result.

The question of opening the thorax by turning up a large flap of the chest wall (including portions of several ribs) so as to deal directly with the injured lung has been raised of recent years, and several cases in which it has been undertaken have been recorded. Further

experience will probably decide that such a procedure is quite unjustifiable except in very unusual circumstances.

The later treatment of these cases is much the same as for simple non-penetrating injuries. Should symptoms of septic pleurisy follow, the wound must be freely opened, a portion of rib being excised, if necessary, and the cavity washed out and drained, as for empyema.

Hernia of the Lung, or pneumocele, is a rare condition in which a portion of the lung protrudes through an opening in the thoracic parietes beneath the uninjured skin. It may occur suddenly, as the immediate consequence of a laceration of the intercostal muscles and pleura, or more gradually, being then due to the yielding of a cicatrix. It is most usually seen about the fifth intercostal space, but has been known to occur in the root of the neck from a lesion in the dome of the pleura. It is recognised by the appearance of a rounded swelling, increasing in size on coughing or making expiratory efforts, and possibly disappearing entirely on holding the breath. It imparts a crepitant feeling to the fingers when compressed, and on auscultation a loud vesicular murmur is heard. As a rule, no treatment is advisable in this condition beyond the application of a pad or truss.

A similar condition, arising as a complication of an open wound, is termed a **Prolapse** of the lung. An attempt should always be made to return the protruded viscus, and to prevent its recurrence by suturing the aperture through which it has escaped. If left unreduced, it is very likely to become gangrenous from strangulation, and should then be removed by the application of a ligature, the wound being subsequently closed.

Empyema, or suppuration within the pleural cavity, results not only from traumatism, but also as a sequela of a simple pleurisy, or as a complication of various affections of the lungs, whilst a basal empyema is not an uncommon result of intra-abdominal suppuration. Bacteriological research has demonstrated that in children more than half of the cases are due to the pneumococcus, either alone or less often in conjunction with streptococci, whilst in adults the streptococcus is the commonest organism. A description of the physical signs and symptoms belongs rather to the physician than to the surgeon. It will suffice to mention here that in a total empyema the affected side of the chest does not move on respiration, whilst the intercostal spaces may bulge; on percussion the side is dull, except perhaps immediately below the clavicle, where tympanitic resonance may be elicited. On auscultation breath-sounds are absent, except in the vertebral groove, where bronchial breathing may be heard. The loss of vocal fremitus is also an important sign. A certain amount of fever and dyspnœa is usually present in cases of empyema, whilst the heart and other viscera may be displaced. Left to itself, an empyema usually finds its way to the surface, and perhaps most commonly bursts through the fifth or sixth costal interspace, though sometimes through the second in front, owing to the perforating vessels being larger here than elsewhere. Occasionally a localized empyema is met with, giving rise to similar effects, but on a smaller scale. When

situated on the left side in close proximity to the pericardium, movements of the heart may be transmitted through the fluid to surface, causing a pulsation which can be seen or felt (*pulsa empyema*).

In the early stages the pleura is but little altered in structu although a certain amount of lymph may be deposited on it; in standing chronic cases it becomes very dense and firm, owing t development of fibro-cicatricial tissue, whilst the surface is conve into a layer of granulation tissue, similar to that found in all chr abscesses. The lung collapses and retreats backwards towards spine; at first its alveolar texture remains unaltered and the e removal of the exudation enables it to re-expand, as a result of atmospheric pressure. In chronic cases, however, there are hindrances to this expansion, viz., the density of the thicke visceral pleura, which resists the atmospheric pressure, and infiltration and sclerosis of the lung tissue itself. Under th circumstances, even when the exudation is entirely removed, lung may remain collapsed, and Nature then attempts in seve ways to remedy the mischief and obliterate the pleural cavi (*a*) The opposite lung undergoes expansion and hypertrophy, together with the heart projects over to the opposite side; (*b*) abdominal viscera and diaphragm are displaced upwards; (*c*) chest wall falls in, and the spine becomes laterally curved, with convexity to the sound side; and (*d*) there is an exuberant growth granulation tissue from the surface of the pleura. In a certain p portion of cases these structural changes suffice to determine a cr but in others a cavity still remains, lined with thickened pyog membrane, and discharging pus or serum, according to whethe not sepsis is present. Under these circumstances extensive oper interference is necessary.

The **Diagnosis** of empyema is readily made by attention t physical signs, and confirmation of such an opinion can be obt by puncture with a sterilized hypodermic syringe. A me sized needle should always be employed for this purpose, an well to insert it along the top of a rib after drawing the skir down, so that on removal a valvular puncture results. The ch of the organisms contained in the sample of pus thus wit should, if possible, be ascertained, since it has been proved **Prognosis** depends much on this point. Thus, an empyem the presence of pneumococci, presumably following a pn runs a mild course, and is readily cured, even by aspiratio one due to the ordinary pyogenic cocci is more acute, and drainage with or without resection of a piece of rib. The of tubercle bacilli renders the outlook much more serious, addition of septic organisms to any of the above aggr process and much impedes a cure. The chronicity or affection is also a most important element in the prognosi later the treatment commences, the denser are the adhe bind down the lung, and the less the chance of its re-expa

character of the pus also varies with the organisms present; with pneumococci, the pus is yellow, creamy and laudable, whilst there is usually an abundant production of fibrinous false-membranes; when of streptococcal origin, the pus is usually thin and oily.

Treatment therefore should never be delayed; the earlier it is undertaken, the better the results.

Aspiration may be adopted in the first instance, but is generally to be regarded as of an exploratory nature, though a cure will occasionally follow when the empyema is of pneumonic origin. It is, however, sometimes of value in order to relieve for a time the pressure on the other lung and the resulting dyspnœa, and thus allow of the administration of an anæsthetic for the more serious subsequent operation.

Drainage of the pleural cavity through an external incision is the treatment almost invariably necessary, and as a matter of mechanical convenience it is usually advisable to resect a portion of a rib in order that the drainage-tube may not suffer compression; especially is this the case in children. The best site for opening a complete empyema has been much discussed, and it is probable that subsequent drainage is facilitated by making the opening well back, *e.g.*, in the ninth space just external to the scapular line. Possibly in children with a pneumococcal empyema, which is not likely to need lengthy drainage, a more convenient site may be selected in the fifth or sixth interspace, just behind the mid-axillary line; apart from these cases, an incision here is usually ineffective, and will require a subsequent counter-opening further back. An incision is made along the course of a rib about 1½ inches in length, and the periosteum stripped up from both the superficial and deep aspects of the bone, so as to enable a curved raspatory to be passed beneath it; at least 1 inch of the rib is then cut away with bone pliers. The parietal pleura is opened sufficiently to enable the finger to be introduced and the cavity explored, as also to allow of the removal of flaky masses of fibrin. A large drainage-tube is inserted, just long enough to project into the pleural cavity, and the wound immediately covered, so as to prevent as far as possible the entrance of unfiltered air.

Formerly it was considered desirable to wash out the pus, but it has now been demonstrated that this is unnecessary and occasionally dangerous. Several cases of sudden death have followed this practice, probably due to reflex irritation of the vagus. In chronic cases, where sepsis has been admitted, irrigation is often beneficial, but the following points must be attended to: (i.) The fluid employed must be unirritating, though sterile; (ii.) it must be at the temperature of the body, neither too hot nor too cold; (iii.) it must not be injected with such force as to impinge against the pleura or against the upper surface of the diaphragm; and (iv.) free exit must be given to it, so as to prevent tension from accumulation within the pleural cavity.

If such treatment is undertaken early, the lung may be expected to expand quickly, the discharge steadily diminishing, and the

wound healing without delay; but, as we have already explained this does not always occur, and then a fistula persists, leading into a cavity lined with a thick pyogenic membrane, discharging a variable amount of pus. The best means of obtaining a cure in these cases consists in removal of the rigid external wall, as by *Estlander's operation*, which is characterized by the excision of portions of ribs comprising the outer wall of the cavity. It is usually carried out through a vertical incision in the axillary line, the ribs being freed from their periosteal connections; the amount excised necessarily varies according to circumstances, and is in some cases very extensive. The fistulous track is enlarged, and the interior of the pleura carefully curetted and washed out, so as to remove all necrotic and degenerating tissue; the parietes are then allowed to fall back into contact, if possible, with the deeper layer, a drainage-tube is inserted, and the side firmly bandaged. A modification of this proceeding is known as *Schede's operation*, in which not only are the ribs removed, but also the intervening tissues, so that the subcutaneous or muscular structures in the flaps are laid down upon the prepared surface of the deeper layer of the pleura.

Necessarily, either of these methods of treatment is associated with considerable deformity, and also with a terrible weakening of the side, and plans have been suggested to obviate this by removing portions of a number of ribs before and behind, so as to leave the intervening segment free to collapse without totally destroying the osseous thoracic boundary. Another proceeding that has been recently practised with occasional success is the stripping of the thickened pleura away from the collapsed lung, so as to enable it expand once more (pulmonary decortication). Obviously such procedure could only be of value when the compression of the lung has not been followed by sclerosis; whilst infection of the pulmonary tissue has resulted in grave inflammatory disturbance and even destruction. It is more than doubtful whether this proceeding is ever justifiable.

Pneumotomy, or incision of the lung, has been undertaken for a few pulmonary lesions, and the results obtained have been rather variable. 1. For *tuberculous cavities* it is of little use. They are usually situated at the apex of the lung and drain well; the original disease is not removed; and the general health is frequently so impaired that the shock of the operation hastens the inevitably fatal issue. Hence it is only required in cavities located in the lower lobe of the lung, which drain badly, and the difficulty of diagnosing such a condition is considerable. 2. For *bronchiectases* pneumotomy, though *prima facie* desirable, has given but little benefit, since it is uncommon for only one dilatation of the bronchus to exist. In suitable cases, however, where there is a good deal of fœtid secretion, which is with difficulty expelled, it may be useful. 3. *Gangrene* of the lung or *pulmonary abscess* usually follow acute septic pneumonia in debilitated individuals. The expectoration is abundant and extremely offensive. The localization is made partly with the stethoscope, but mainly with the exploring needle. The gangrenous area is often at the base of the lung. Operation is frequently successful. Of course

pulmonary abscesses of pyæmia, being multiple, are not suited to operative treatment. 4. In *hydatid* disease of the lung, incision and drainage have so considerably reduced the mortality that this method of treatment should alone be adopted.

As to the *technique* of the operation, the first thing is to locate the mischief, and this is effected partly by a careful attention to the physical signs, partly by the use of an exploring needle or syringe. An incision is then made, and a portion of one or more ribs removed. If the lung is adherent to the thoracic walls, and shows no signs of retracting, the operation may be continued; but if no adhesions are present, it may be well to pack the wound with gauze for a day or two, so as to determine their formation and thus shut off the pleural cavity. The lung itself may be punctured with sinus forceps introduced along an exploring needle, and then opened, or may be incised with a cautery. The abscess or other cavity is thus emptied of its secretion, and a drainage-tube inserted. As a general rule it is unwise to scrape or irrigate it, for fear of a communication existing with any of the larger bronchi.

Pneumectomy, or excision of a portion of the lung, has been attempted in a few cases of tuberculous disease limited to the apex; the operation is, however, quite unjustifiable, since, if the affection is localized to the apex, it can often be cured by hygienic measures, whilst if it is more diffuse it cannot be extirpated. Primary malignant tumours of the lung, moreover, are usually central, and the diagnosis can rarely be made early enough to warrant an attempt at removal. The only conditions under which it is justifiable to excise portions of lungs are: (*a*) when a hernial protrusion has become strangled through a small opening, and cannot be reduced; and (*b*) when malignant disease of a rib has invaded the superficial portion. In the former case, the base of the protrusion is transfixed and ligatured prior to being cut away; in the latter, the disease is snipped away with scissors, and bleeding stayed by cautery, ligature, or plugging.

Wounds of the Heart.

Wounds of the Heart and great vessels are so usually fatal either immediately or within a few hours, that it is unnecessary to discuss them here in any detail. If the patient does not die at once, he suffers from intense shock and prostration, combined with a weak and turbulent action of the heart, great pain in the chest and dyspnœa, whilst the pulse is scarcely to be felt. Free hæmorrhage occurs if there is an external wound, but if the opening in the pericardium is small and valvular, the heart's action may be brought to a standstill by the pressure of the blood within. Should the patient survive, pericarditis generally supervenes, and is often of a purulent type. As to *Treatment*, the great essential is to keep the individual absolutely quiet, and with the head low. The external wound should be purified, but during the stage of primary shock no attempt should be made to explore it, either by finger or probe, for fear of dislodging

usually undertaken close to the left border of the sternu interspace, or 1½ inches from the left margin of that bon fourth or fifth interspace, so as to avoid the internal ma which courses down about a finger's breadth from the l

For suppurative pericarditis an incision may be mad situation after removing the fourth or fifth costal cartila washed out, and even a drainage-tube inserted. Care i to prevent infection of the mediastinal tissues, and th times be accomplished by stitching the pericardium t before opening it.

Asphyxia.

Asphyxia, or **Apnœa**, is the term applied to indicate the condit interference with or stoppage of the respiratory act. If this has i any great extent it is termed **Dyspnœa**; when, however, the o marked that the patient is obliged to maintain the upright sitti term **Orthopnœa** is applied to it.

The **Causes** of asphyxia may be classified as follows:

1. Conditions arising from the presence of abnormal contents passages, *e.g.*, foreign bodies, blood-clot, or pus from the burstin or aneurism; serum, as in œdema of the lung; mucus or m bronchitis; the consolidated exudation in pneumonia; diphther or irrespirable gases; *e.g.*, nitrogen, hydrogen, carbonic acid suffocation. Death by drowning usually arises from a similar replacement of air by water in the respiratory passages.

2. Causes arising in the walls of the air-passages, such as dim lumen from inflammatory congestion, as in œdema of the glo stenosis; the presence of new growths, or the displacement of throat; or the falling back of the root of the tongue after partial organ.

3. Extrinsic causes, or those arising outside the air-passages, strangling, hanging, garrotting, etc.; the presence of tumours, su aneurisms; a retro-pharyngeal abscess or tumour, and, under exc stances, displacement backwards of the sternal end of the clavic *thorax* gradually increasing obstruction to the respiration may b

The **Treatment** of the different conditions giving rise to asphyxia cannot here be dealt with *in extenso*. We can only indicate the general plan of treatment to be adopted. A rapid examination is at once made, to ascertain, if possible, the cause of the mischief, and whether its onset has been gradual or sudden. If it has been gradually developing, it is not uncommonly due to some thoracic condition which cannot be relieved; if, however, its onset has been sudden, and not the result of any evident lesion, the neck and chest should be bared, and examined for signs of traumatism, the mouth opened, the tongue drawn forwards, and the glottis examined with the finger to see that the passages are clear. The patient should, if necessary, be removed into fresh air, and artificial respiration at once commenced. Breathing can sometimes be excited by alternately dashing hot and cold water over the thorax, whilst electric stimulation of the phrenic nerve may also be undertaken, one electrode being placed over the neck, and the other on the epigastrium. The administration of oxygen instead of air is useful during the earlier stages, whilst if the condition is due to cardiac disease with distension of the right side of the heart, venesection holds out the best hope of relief. Obstruction within the larynx needs tracheotomy or intubation, as also other conditions associated with pressure on the trachea.

Artificial Respiration is required in a variety of surgical conditions, and can be undertaken by what is known as Sylvester's method. In this the patient lies on his back, with a pillow beneath the shoulders, the mouth opened, and the tongue drawn forwards. The arms are then grasped just above the elbows and drawn upwards above the patient's head, so as to expand the chest through the action of the great pectoral muscles. This position is maintained for about two seconds, and then the arms are lowered to the side, and pressed firmly against the ribs, so as to determine a forcible expiratory act. At the end of about two seconds more the arms are again elevated, and the same cycle passed through. This should be repeated about fifteen times a minute, and the operator must be careful not to use too great violence, or to unnecessarily hurry over it, as harm rather than good thereby results.

Another less satisfactory method consists in alternately compressing the lower part of the thorax and abdomen with the hands, so as to drive out a certain amount of air, and then by suddenly relieving the pressure the elastic expansion of the chest walls draws in a fresh supply.

In the **Treatment of the Apparently Drowned** the air-passages must be cleared as quickly as possible. During the struggles of the drowning man water enters the trachea and is churned up with mucus, saliva, and perhaps blood into a froth which does not easily escape, but must be slowly squeezed out by the application of pressure to the back, whilst the patient is lying face down. At the same time artificial respiration must be maintained, and it is obvious that Sylvester's method is not an ideal plan under these circumstances. Dr. R. L. Bowles has elaborated a procedure for these cases which admirably suits their requirements, and we have much pleasure in quoting his instructions *verbatim*, and introducing the illustrations which he has kindly placed at our disposal:

'Treat the patient at once and on the spot. Undo any tight clothing. Kneel and place the patient on the right side and quickly wipe out the mouth and throat.

'If there are no signs of breathing, spread a handkerchief on the ground where the patient's mouth will come, and carry out

'*Movement No.* 1.—Turn the patient flat on the stomach, and at once with widespread hands press gently but firmly for three or four seconds on the back of the ribs on both sides to squeeze out the froth, fluid, or foul air (Fig. 342). Then suddenly remove the hands

to allow the entrance of air by the natural recoil of the ribs, a
proceed to

'*Movement No.* 2.—With the right hand grasp the patient's l
shoulder; with the left hand take his left wrist, place it against l

FIG. 342.—TREATMENT OF THE APPARENTLY DROWNED—MOVEMENT No. 1

FIG. 343.—TREATMENT OF THE APPARENTLY DROWNED—MOVEMENT No. 2

hip, and roll him towards you on to his right side (Fig. 343). T
movement should take about two seconds.

'Repeat first and second movements in succession for ten minu

or more (if necessary), when some of the froth or fluid will have drained away from the lungs, and then proceed to

'*Movement No.* 3.—Each time the patient is rolled from the stomach on to the right ride, take hold of the left or uppermost arm and raise it above the head in a line with the body. This movement expands the chest still more and allows air to enter the upper left lung (Fig. 344). Then bring the arm down to the side, roll the patient on to the stomach, and begin again at movement No. 1, and

FIG. 344.—TREATMENT OF THE APPARENTLY DROWNED—MOVEMENT NO. 3.

continue each movement in succession as before, for an hour or until signs of natural breathing begin.

'Always turn the patient on to the right side, never on the left, and under no circumstances on the back. From time to time wipe away froth from the mouth and nose.

'The neck should be kept fairly straight and the chin away from the breast-bone; the head may then be left to take care of itself, and the face will take no harm, as it will remain chiefly on its side, and yet perfect drainage will be ensured.'

CHAPTER XXXIII.

DISEASES OF THE BREAST.

Congenital Malformations of the breast are much more common than is usually supposed. One or more accessory breasts (*polymastia*) or nipples are found either below the normal one or just above it, but sometimes they have been found in the axilla, on the outer side of the thigh, or other curious situations. They are often of a most rudimentary nature, but in a few cases they have secreted milk. The existence of these structures probably explains the occasional origin of cancer in unusual situations, such as the axilla. Very rarely the breasts are entirely absent (*amazia*). Occasionally the male breast becomes enlarged to the size of an ordinary virgin's breast (*gynecomastia*); the organ is usually functionless, although lactation has been known to occur, and the overgrowth mainly affects the stroma. The condition may be associated with imperfect or irregular development of the sexual organs.

FIG. 345.—DIFFUSE HYPERTROPHY OF THE BREASTS.

It occurred in a girl aged sixteen and a half years, and both organs had to be removed. The left breast weighed 9½ lbs., the right breast 9 lbs.

Diffuse Hypertrophy of the breast (Fig. 345) consists of a general enlargement of the organ, both gland substance and interstitial tissue participating in the process, and hence the breast becomes firm and indurated. It may be uni- or bi-lateral, perhaps more frequently the latter, and generally occurs in adolescents. The size varies considerably, but the breasts may become enormous,

hanging down by their weight, and perhaps to such an extent as to rest on the knees of the patient when sitting. They are usually painless, although sometimes neuralgia is noticed. Functionally they are useless, as even if the patient becomes pregnant, secretion of milk but rarely occurs. No cause can be assigned for the overgrowth, and the only treatment is amputation, when the increased size is causing discomfort.

Affections of the Nipple.

Fissures of the Nipple (cracked nipples) seldom occur apart from lactation, and may usually be traced to a want of care and cleanliness on the part of the mother, associated with a tender condition of the skin, which might have been prevented by bathing the parts during the later weeks of pregnancy with spirit, so as to harden them. The actual lesion is brought about by leaving the nipples wet after nursing. The superficial layers of epithelium become macerated, and are easily rubbed off, thus exposing the more delicate and sensitive deeper parts, which are irritated and inflamed by the repeated acts of suction. As a result, nursing becomes painful, and if persisted in, the wound may be infected, the inflammation spreading to the breast substance along the ducts or lymphatics, or extending along the superficial lymphatics to the axillary glands.

FIG. 346.—CHANCRE OF THE NIPPLE. (FROM PHOTOGRAPH AND SKETCH LENT BY PROFESSOR RUSHTON PARKER OF LIVERPOOL.)

Treatment. — The best way to prevent the occurrence of cracks is to bathe the nipples with some dilute antiseptic, such as boric acid lotion, immediately after nursing, and then to dry them thoroughly. If at all tender, a little powdered boric acid and starch may be dusted over them in the intervals. When a fissure has formed, it should be dressed with cooling or antiseptic lotions—*e.g.*, lotio plumbi or lotio acidi borici. Sometimes more stimulating applications are required, such as a solution of sulphate of copper, or even of nitrate of silver. It is also recommended to paint the sore with equal parts of glycerine and sulphurous acid.

Eczema of the Nipple may be of a simple nature, needing nothing

but ordinary treatment, or it may take on special features, being then known as **Paget's Disease** (*dermatitis maligna*), a condition really due to a carcinomatous development in the skin. It is seen, but very rarely, in parts other than the breast. It presents a smooth, red, raw surface, discharging an abundant yellowish viscid fluid, and may occasionally spread widely beyond the areola. It is almost invariably followed by a cancerous tumour beneath the nipple, which may resemble either a duct cancer or an ordinary scirrhus. No local treatment is of any avail, and the disease, when once recognised with certainty, is best treated by removal of the breast and axillary glands.

Abscess of the Areola is not uncommon in young girls about the age of puberty, arising in the sebaceous follicles, and requiring no special notice.

Chancre of the Nipple (Fig. 346) is rarely seen in the mothers of syphilitic children (Colles's law, p. 152), but much more commonly in wet nurses. It usually presents as a shallow ulcerated surface with a well-marked, raised, and indurated border. Not uncommonly the condition is symmetrical.

Primary Tumours of the Nipple are met with, such as papilloma, sebaceous cysts, and occasionally epithelioma.

Inflammatory Affections of the Breast.

Acute Mastitis is naturally most often observed in *puerperal* women, owing to the sudden establishment of function in the breast after the birth of a child, and to its maintained activity during lactation. It results most commonly from a sore or cracked nipple, through which pyogenic organisms find their way into the breast substance, either along the lymphatics or the gland ducts. In the former case the inflammation is mainly interstitial in character, the pus diffusing itself widely between the lobules; in the latter the pus forms primarily within the alveoli of the glandular substance, but subsequently spreads beyond it. Simple obstruction to one or more of the ducts from inflammation of the nipple, without any external wound, also determines an attack of mastitis, which is frequently non-suppurative in character. In *non-puerperal* women acute mastitis may result from injury, or may be pyæmic in origin. Occasionally a metastatic inflammation of the breast occurs after the disappearance of the parotid swelling of mumps; whilst in girls about the age of puberty a subacute inflammation, involving both the breast and areola, and even terminating in suppuration, has been observed. In newly-born infants a similar inflammation, occasionally running on to suppuration, has been seen, possibly resulting from an infection of the gland ducts during birth with cocci from the maternal passages. A slight enlargement, with congestion of the breasts, often occurs after birth, and may be due to, or is certainly aggravated by, the foolish habit followed by ignorant midwives of pulling or forcibly squeezing them in order 'to break the nipple-strings.'

Signs and Symptoms.—An inflamed breast is characterized by

organ becoming swollen, acutely painful, and tender. The gland lobules are felt to be enlarged and indurated, whilst if lactation is progressing, the secretion is to some extent impaired; but owing to the inability of the mother to allow the child to relieve the organ, on account of the pain produced thereby, considerable tension results from accumulation of milk. If suppuration follows, the skin over the breast becomes red and œdematous, and, according to the situation of the pus, three different forms of acute abscess of the breast are described: (*a*) *Supramammary abscess* is the term applied to a collection of pus in the subcutaneous tissues; it is often entirely unconnected with the organ, or may originate in the superficial lobules. It is strictly limited, and does not burrow deeply, coming readily to the surface. (*b*) An *intramammary abscess* is that most commonly met with, the pus developing within, and distending the lobules, or infiltrating the cellular tissue around them; it is usually diffused widely throughout the organ, and may point at several spots. When very acute, or in debilitated women, especially if it has been allowed to progress without treatment, the inflammatory process may actually determine gangrene of the glandular tissue. (*c*) A *submammary abscess* is one forming in the cellular tissue beneath the breast. It may spread from the deep lobules, but more frequently arises in connection with disease of some of the adjacent ribs or cartilages, or as a cellulitis. In these cases the breast is pushed forwards, and becomes prominent, floating, as it were, on a bed of pus. The abscess usually points at the periphery of the organ, perhaps in several places, but most commonly at the lower and outer quadrant.

Inflammation of the breast occurs in women who are anæmic and weakly. Even the simple forms are associated with some fever and malaise, and this becomes greatly exaggerated if suppuration ensues, owing partly to the severe pain thereby induced, and partly to the absorption of toxins.

The **Treatment** of simple acute mastitis consists, in the first place, in supporting the inflamed gland by means of a sling or bandage, and in binding the arm to the side, so as to keep at rest the pectoral muscle, on which it lies. Fomentations are then applied, and any tension due to retained secretion is relieved by the breast-pump. The bowels are opened, and the patient placed on a light and nourishing diet, whilst stimulants and tonics, such as iron and quinine, may be judiciously administered.

As soon as the acute stage has passed, friction with warm oil, or the inunction of a belladonna ointment, is advisable.

When suppuration is threatening, the breast may be poulticed until fluctuation is detected; but under no circumstances must the abscess be allowed to burst into the poultice, and thus become septic. If such a practice is permitted, chronic suppuration ensues, and the breast may become riddled with sinuses. The most rigid asepsis must be maintained in these cases, and as soon as pus is evidently present, an incision should be made to permit of its escape. In the *supramammary* variety it matters little in which direction the cut is

made, since the pus is always superficial to the breast tissue. In the true *intramammary abscess* the incisions should radiate from the nipple. One or more may be needed, and these should be made with a free hand, so as to allow of the insertion of the finger, and the opening up of any pockets or lobules which are distended with matter. A drainage-tube is inserted for a time, and gradually shortened day by day, until its entire removal is permissible. When the chief incisions are needed above the nipple, it is often wise to make a counter-opening in the lower half of the breast, and generally on the outer side, to permit of more efficient drainage. With such treatment the best of results may be attained, and it is interesting to note how quickly the contour of the breast is restored, and how slight is the permanent injury inflicted on the parts. The *submammary abscess* is best opened towards the lower and outer side, but also at any spot where pus points.

If septic sinuses persist after an abscess has burst, their orifices should be enlarged, and their walls thoroughly scraped and disinfected; deep cavities should be efficiently drained and stuffed with gauze, so as to ensure the wounds healing by granulation.

Chronic Mastitis occurs in two forms—one, a localized affection of one segment of the breast (chronic lobar mastitis), the other involving the smaller lobules and interstitial tissue (chronic lobular or interstitial mastitis).

1. **Chronic Lobar Mastitis** is by no means unfrequent as a result of imperfect involution of the organs at the cessation of lactation, but may arise from blows or squeezes, and especially in young women it may also follow a subacute or acute attack, which has not ended in suppuration. It is characterized by an enlargement of one or more lobes of the organ, which are usually tender, and often excessively painful, the pain being of a neuralgic character, and increased during menstruation. The condition is of comparatively little importance, but may give rise to a great deal of anxiety and worry. All that is necessary in the shape of **Treatment** is to support the part and keep the arm at rest in a sling, whilst an ointment containing belladonna, or a belladonna plaster, may be applied.

2. **Chronic Lobular or Interstitial Mastitis** is an affection of much interest, which occurs most frequently in women with small or atrophic breasts, who have passed, or are near to, the climacteric, being then merely an exaggeration of the sclerosis which occurs normally at that epoch. It is, however, sometimes met with at an earlier age. It may involve the whole of one or both breasts, or may be limited in its development to a portion of one breast, and is then likely to be mistaken for a malignant tumour. **Pathologically**, it is characterized by diffuse overgrowth and infiltration of the connective tissue, which becomes sclerosed and thickened. This is associated with well-marked epithelial proliferation, so that sometimes in the earlier stages the acini are filled with a thick cheesy or granulous material which can be squeezed out in thread-like masses, often of a dirty brown or greenish-yellow colour. Cysts are formed in the

gland tissue, partly by liquefaction of this proliferated epithelium, partly by exudation into the acini of serous fluid, which is unable to find an exit owing to the pressure of the interstitial growth. Such are known as 'involution cysts,' and the fluid contained therein is usually clear and limpid; but may be brown and turbid, from admixture of blood; intracystic growths are not present. As a rule, many of these cysts are scattered widely through the breast substance, but they are small and insignificant; occasionally one or more of them become notably enlarged, and give the patient the impression of a tumour.

Clinical History.—The condition often passes unnoticed in the early stages, until a distinct lump has formed, which is nodular and indurated to the touch, and often very painful. The breast may be somewhat enlarged, and there is, perhaps, some retraction of the nipple, owing to contraction of the interstitial tissue; but this is by no means an essential feature. A scanty serous discharge from the nipple is sometimes noticed. The skin seldom becomes adherent to the swelling, whilst the lymphatic glands in the axilla may be enlarged and tender owing to sympathetic irritation. On careful examination of the breast, the affection is rarely limited to one particular region, for although a distinct enlargement of one portion may be present, yet the whole organ feels more or less 'lumpy,' and not unfrequently the other breast participates in the same change. Small, rounded, elastic spots can often be detected on careful palpation, and indicate the presence of cysts. There may be but little pain, although this is sometimes one of the most marked features of the case; it is of a neuralgic type, and usually increased at the menstrual periods.

If left to run its course, the disease may remain much in the same condition for many years, and even in time disappear; but more frequently it slowly progresses, and then results in one of three conditions: (*a*) *General atrophy*, the breast becoming shrunken, hard, and nodular. (*b*) More frequently *general cystic disease* follows, a condition in which the organ becomes transformed into a number of cysts held together by dense connective tissue. (*c*) There is some question as to whether or not *cancer* is a sequela of this disease; but there is abundant evidence to prove that any continued source of irritation in an organ like the breast renders an individual with a cancerous tendency more liable to its development.

The **Diagnosis** is sometimes easy, but the condition often simulates somewhat closely a scirrhous tumour. The chief points of distinction, however, lie in the facts (i.) that the whole breast is more or less involved; (ii.) that the opposite organ is very often similarly affected; (iii.) that enlargement of the axillary glands is less common than in scirrhus, and even if enlarged they are not hard, as in the latter disease; (iv.) that the skin is usually free from the mass; (v.) that the tumour is never adherent to the pectoral fascia, nor is it of the stony hardness of a scirrhus; and (vi.) that it is often more disseminated and less defined than a cancerous growth. (vii.) Moreover, on careful palpation with the flat of the hand, it is often impos-

sible to make out any distinct lump, the so-called tumour merging into the surrounding tissues; this never occurs in scirrhus, the growth always being easily detected with the flat of the hand. Small cysts can also be felt as localized elastic spots in the inflammatory mass. Of course it is possible for the two conditions to co-exist, and in doubtful cases an exploratory incision, and microscopic examination of a portion of the tissue, can alone be depended on.

Treatment.—In the early stages friction with some sedative application may be used at the same time that the breast is supported, and freed from the irritation of badly-fitting stays. Firm and equable pressure, as by strapping, is also useful in some cases, whilst iodide of potassium may be administered. If a definite tumour is present, or if many cysts can be detected, and especially if the patient is anxious and worried about herself, it is wise to remove the affected portion, or even better to excise the whole breast, especially when there is a family history of malignant disease.

Localized or Encysted Chronic Abscess is usually associated with pregnancy, and is characterized by the formation of an indurated mass in the breast substance, which slowly softens, giving rise to a sense of fluctuation, although when the abscess walls are very thick, as is often the case, it may be exceedingly difficult to detect this. Retraction of the nipple is not uncommonly present, and the axillary glands may be enlarged. The condition has frequently been mistaken for a tumour, but is recognised from it by its incorporation with the breast substance, by its lack of definition, and by the fact that on careful examination elasticity can be felt at its centre, which is almost always less resistant than the margin, whereas the opposite is the case with a tumour. In cases of doubt the insertion of a grooved needle or an exploratory incision will settle the diagnosis. Some few of these chronic abscesses of the breast are of a tuberculous nature.

Treatment consists in opening the abscess cavity, scraping out its interior, disinfecting with pure carbolic acid, if tuberculous, and draining or stuffing it.

Diffuse Tuberculous Disease of the breast is not so uncommon as was formerly supposed. Scattered nodules of caseous material are developed in the interacinous tissue, which break down into pus, and come to the surface at various spots. The breast may thus become riddled with sinuses discharging caseous pus. It may be associated with tuberculous disease of the lungs, whilst a like affection may arise secondarily in the axillary glands; possibly in some cases the primary trouble lies in the glands, the breast being subsequently involved.

Treatment should be carried out, if possible, by incision, scraping, and purification of the cavities; but if the tuberculous foci are multiple, it is wiser to amputate the breast.

Occasionally a *chronic tuberculous submammary abscess* forms as a result of a similar affection of the ribs or costal cartilages. It develops slowly, pushing the breast forwards, and is easily recognised,

although the causative lesion can only be ascertained by exploration. It must be opened thoroughly, and its wall scraped and disinfected, whilst attention is also directed towards the affected bone.

Syphilitic Diseases of the Breast.—As already pointed out, a primary sore may be met with on the nipple; secondary mucous tubercles, or condylomata, are found in a similar situation or beneath a pendulous breast, whilst superficial and deep gummata have in rare cases formed in the tertiary period of the disease.

Cysts of the Breast.

When the structure of the breast, its abundance of ducts and alveoli, and its complex lymphatic distribution are considered, it is not surprising that many different forms of cystic change are associated therewith. The following are the more important:

1. **Acinous or Retention Cysts** arise, as the name suggests, from some obstruction to the ducts or lobules, whereby the secretion of the organ is unable to escape. They are met with most frequently in women during or after the puerperal period, a milk cyst, or *galactocele*, being then produced. It usually results from compression of one or more of the ducts, connected with a sore nipple, and contains inspissated milk; it forms a rounded swelling, and is located near the nipple. The wall is lined with cuboidal or columnar epithelium, according to whether a portion of the lobule or the duct itself is implicated; if, however, it attains any great size, the epithelium may become flat and squamous. This is surrounded by a fibro-cicatricial layer, the thickness of which increases with the chronicity of the case. It is treated by laying the part open, removing the contents, and stuffing or draining the cavity.

Similar glandular cysts form, as already described, in the course of chronic interstitial mastitis, and are then known as *involution cysts*; in long-standing cases, general cystic disease of the breast may supervene.

Retention cysts have also been described as resulting from irritation of the nipple, as, for instance, when a young non-pregnant woman constantly puts a baby to her breast; the organ becomes enlarged, the epithelium proliferates, and a thin serous fluid is secreted, which does not entirely escape and by its distension of the lobules gives rise to what may be termed *irritation cysts*. They may in time undergo spontaneous absorption, but Erichsen describes a case of this nature in which the swellings did not disappear until the patient subsequently became pregnant.

Again, one frequently finds cystic dilatation of the ducts and lobules arising in connection with certain tumours of the breast, such as duct papilloma, duct cancer, or cysto-adenoma. In the latter cases hæmorrhage from the contained growth is often seen, giving rise to a blood-stained discharge from the nipple. A scirrhous growth also occasionally starts from the wall of an acinous cyst.

In most of these retention cysts, discharge from the nipple occurs on squeezing the organ.

2. **Interacinous Cysts** develop in the interstitial tissue of the breast.

(*a*) **Serous Cysts** originate, it is supposed, from a dilatation of lymph spaces. They may be uni- or multi-locular, perhaps more frequently the latter. They are lined by a smooth, shiny layer of endothelium, and contain serum, perhaps blood-stained, and in old-standing cases cholesterine; being separate from the gland substance, they never give rise to a discharge from the nipple, and intracystic growths are unknown. They are usually surrounded by a wall of connective tissue which may become exceedingly thick and dense. Occasionally, however, they project under the skin, and if the walls remain thin, fluctuation, and even translucency, can be observed, leading to the condition sometimes badly termed a ***hydrocele of the breast.***

The **Diagnosis** of a serous cyst, if the wall is thick, is often a matter of considerable difficulty, as it resembles in many ways a scirrhus. It is recognised, however, by the facts that the growth is incorporated with the breast substance, usually occurring near its under surface; that on careful examination an elastic resistance is transmitted to the fingers, quite distinct from the stony hardness of a scirrhus; that there is no retraction of the nipple and no enlargement of the axillary glands, whilst, as a rule, the patient complains of but little pain. The diagnosis in cases of doubt may be readily determined by inserting a grooved needle, or by an exploratory incision, which should be made of sufficient depth to ensure the thorough division of the mass, for fear that a small cyst surrounded by walls of fibrous tissue, half an inch, or even an inch, in thickness should be mistaken for a solid tumour.

Treatment.—Although it may suffice to lay the cavity open and drain it, it is decidedly wiser to remove it completely.

(*b*) **True Hydatid Cysts** are occasionally met with, manifesting the general characteristics described at p. 220.

3. Cysts may also arise in connection with cancerous or sarcomatous tumours, from degeneration of tissue in the former case and from hæmorrhage into the substance of the latter.

4. **Dermoid Cysts** are described; but it is a little doubtful whether old galactoceles have not been mistaken for them.

Tumours of the Breast.

In investigating any case of tumour of the breast, the surgeon must never arrive at a hasty conclusion, but only give an opinion as to its nature after careful and detailed examination. Thus, the age and previous history of the patient should be considered, as also the family history. Simple tumours generally arise at an earlier age than the malignant, whilst the sarcomata usually affect younger individuals than the carcinomata. There can be little doubt, moreover, as to the occasional tendency of tumours to run in families. The length of time for which the swelling has been observed should be ascertained, and whether or not it varies in size at the menstrual

periods. The general appearance of the patient should be noted, as also the fact whether or not pain, local or neuralgic, is experienced. It is not unusual for pain to be referred to that part of the shoulder supplied by the posterior division of the second intercostal nerve, the anterior branch of which goes to the breast. A careful inspection of the organ should then be made, comparing it with the opposite breast, so that any signs of asymmetry may be noted. Dimpling of the skin, projection of the tumour or of the whole gland, and the situation and condition of the nipple, are the chief points to which attention should be directed. Examination of the tumour with the flat of the hand, accompanied by gentle pressure of the finger-tips, must then be undertaken; it is not enough to pick up the breast substance between the fingers, as thereby false impressions are obtained. The relation of the tumour to the gland, its shape, its consistency, whether fluctuating or not, and its mobility on superficial, deep, and surrounding parts, should all be investigated. To this end the breast must also be examined with the arm raised well above the head, so as to put the fibres of the pectoralis major on the stretch; transverse movement of the organ across the fibres is always possible, unless the growth is fixed to the thoracic wall; movement in the direction of the fibres is at once limited if the tumour has invaded the muscle, or even if the overlying fascia is seriously involved. Finally, the lymphatic glands in the axilla must be carefully examined, as also, in suspicious cases, the supraclavicular glands and the opposite breast and armpit.

The chief types of tumour met with in the breast may be arranged in three groups: the adenomata, the sarcomata, and the cancers. A few other conditions have been observed, but are so rare that they need no special description, *e.g.*, lipoma, fibroma, chondroma, and osteoma.

Adenoid Tumours of the Breast.—This group includes the two forms of fibro-adenoma (the hard and the soft) and the cysto-adenoma. All are characterized by the existence of spaces lined with epithelium, which does not extend beyond the basement membrane. The spaces may contain a variable quantity of fluid, and in some cases intracystic growths are a prominent feature. The interstitial tissue is sometimes of a very embryonic type.

A pure **Adenoma** is said to occur, but is very uncommon. Its texture would be identical with ordinary mammary tissue, and its characters with those of a fibro-adenoma, except that it is a little softer.

The Hard Fibro-adenoma (or **Adeno-fibroma**) is the most common mammary tumour met with in young people before the age of thirty; it is often attributed to a blow or squeeze, and doubtless correctly. It occurs as a more or less rounded or oval mass, which, if placed superficially, moves freely in the breast substance, and, indeed, may be described as floating in it (Fig. 342); if situated deeply, it still appears freely moveable, but its definition is less evident. Sometimes several such growths are found in the same breast. A fibro-adenoma is usually firm and more or less elastic in consistency, of slow growth, and it may be either painless, or in anæmic and neurotic

women exceedingly painful, the pain often inci
periods. There is no concurrent enlargement
unless arising from other causes, and no re
with which it is entirely unconnected; th
dimple. The general health is unimpaired
suffering from an associated anæmia. On se
tumour is of a grayish-white colour, becomir
the air. It is more or less foliated in textu
Virchow to the section of a cabbage; no ju
scraping the cut surface with a scalpel, alth
fluid of a thick glutinous or mucoid nature ma

FIG. 347.—FIBRO-ADENOMA MAMMÆ. (FROM MUS
OF SURGEONS.)

cally, the tumour consists of imperfectly d
ments, surrounded by a considerable amou
tissue, but ducts are never present. The tun
suled, except at the one spot, through whic
which it is connected with the neighbouring
stated that fibro-adenomata are occasionally c
thus changing their type from simple to malig
ever, as to this is not conclusive.

The **Diagnosis** is readily made if the above
An adenoma differs from chronic interstitial
cyst by its exact definition and free mobility,
tumours it is distinguished by its slow rate of g
from adhesions either to the skin or to surrour

The **Treatment** consists in its removal, which is easily effected by cutting down upon the tumour in a direction radiating from the nipple, until the capsule is reached, when the mass is enucleated from its surroundings with a few touches of the knife. When the growth is present in the upper half of the breast, a crescentic incision may be made along its lower border, and by burrowing upwards under the organ, the tumour can be removed from behind; the scar will be subsequently hidden.

The **Soft Fibro-adenoma** differs from the above mainly in the increased rate of growth, in its soft consistency, and in the fact that the interstitial tissue is of a more embryonic character, and, indeed, is often of a mucoid nature; it is sometimes incorrectly termed an adeno-sarcoma. It usually occurs in women at a somewhat earlier period of life than sarcoma or cancer—viz., between the ages of twenty-five and thirty-five. It may consist from the first of a localized tumour, increasing rapidly in size, or it may possibly commence as a hard fibro-adenoma, which, after remaining quiet for a time, takes on a more active development. It remains, however, throughout its course strictly encapsuled, and when large may lead to pressure-atrophy of the true gland substance. It is soft and elastic in consistency, usually painless, and freely moveable on the surrounding breast tissue. The skin over it remains healthy, although distended and atrophic when the tumour is of large size; the nipple shows no sign of retraction; the axillary glands are not involved, and there is no systemic invasion. On removal the section is similar to that of a fibro-adenoma, but cysts are often present, as also areas of mucoid softening, somewhat resembling sago. It can be readily removed in its entirety, and does not tend to recur.

Cysto-adenoma (*Syn.:* **Cysto-sarcoma, Adenocele, Intra-canalicular Adenoma,** etc.) is a condition characterized by a marked development of intracystic growths, fibro-papillomatous in nature, within the dilated acini of a newly-formed mass of adenomatous tissue, or within the smaller ducts (Fig. 348). It usually has a definite capsule, and then the normal gland tissue may be pressed aside, and perhaps atrophies. Several cysts are, as a rule, present, and may be of great size, the intracystic growths also varying in amount. Sometimes there is only one large cauliflower-like mass in a cyst; sometimes there are several smaller pedunculated growths. They are covered with epithelium, which is cuboidal or columnar; they are exceedingly vascular, and hæmorrhage into the cavity of the cyst frequently occurs, as also a blood-stained discharge from the nipple. They are due to a proliferation of the interacinous tissue, which pushes the epithelial wall of the duct or acinus before it. The tumour produced is irregular in outline, owing to the projection of the cysts; it is usually painless, and unaccompanied by enlargement of the axillary glands; if of large size, blue veins are seen coursing over it. In the later stages the capsule becomes adherent to the integument, and, finally, owing to the pressure of the tumour, the skin may give way, allowing the growth to protrude. This will be followed by the

development of a fungating mass, which bleeds readily, and becomes extremely offensive. With care a probe can be passed between the intracystic portion of the growth and the thinned and stretched skin, which has merely given way, and is not incorporated with it; this fact is a ready means of distinguishing this condition from a fungating encephaloid cancer. The tumour is essentially benign in nature; it is never disseminated generally, and can be readily and completely removed, so that there is but little tendency to recur. In the early stages it is unnecessary to take away the entire breast if the tumour can be efficiently dealt with otherwise, but in the later stages the whole organ should be excised.

Somewhat similar in nature to the above is the condition known as a **duct papilloma.** This is characterized by the development of a soft

FIG. 348.—CYSTO-ADENOMA MAMMÆ. (MUSEUM OF ROYAL COLLEGE OF SURGEONS.)

The fibro-papillomatous growths are seen projecting from a large cyst, into whi[illegible] a bristle, passed down the nipple, enters. A glass rod has been pass[illegible] through a perforation in the skin into the cyst.

polypoid papillomatous mass, generally of small size, in the interi[illegible] of one of the terminal galactophorous ducts, which in consequen[illegible] becomes dilated. A discharge of blood-stained serum results, a[illegible] there is usually but little tumour to be felt, although the nip[illegible] may be slightly pushed forwards and rendered prominent. It is oft[illegible] the precursor of a duct cancer. Amputation of the breast will in ma[illegible] cases be needed, but it may be feasible in some to deal with t[illegible] tumour alone.

Sarcoma of the Breast is not a common disease (2 to 8 per cent. [illegible] all mammary tumours). It originates in the connective tissue of [illegible] organ, being deeply placed in its substance, or perhaps more [illegible] quently developing in the outer and upper quadrant. It is of t[illegible] chief types: (*a*) The *round-celled* sarcoma forms a soft, somew[illegible] elastic swelling, which grows rapidly, and although often limite[illegible]

first by a fibrous membrane, the capsule sooner or later gives way, allowing the growth to become diffused through the organ. It sometimes gives rise to secondary growths in the axillary glands, or becomes disseminated throughout the body by means of the blood-vessels. Cysts often occur in its substance, resulting either from hæmorrhage or occasionally from the dilatation of an incorporated glandular alveolus; in the latter case the cavity will be lined with epithelium. Myxomatous changes are also not unfrequently observed, and in the more rapidly growing recurrent tumours the mass is often a true myxo-sarcoma. It usually occurs in women between the ages of thirty and forty, *i.e.*, somewhat earlier than scirrhus, whilst its rapid growth and the absence of retraction of the nipple or dimpling of the skin are useful diagnostic features. Should pregnancy follow, the tumour may increase in size at an alarming rate. In the infiltrating forms it is almost impossible to distinguish it from encephaloid cancer, except on microscopic examination. (*b*) A *spindle-celled* sarcoma, or fibro-sarcoma, is also met with, forming a rounded or oval tumour, more limited than the above, and growing somewhat less rapidly. It somewhat simulates an adenoma, but is more closely connected with the breast substance. The axillary glands are but rarely involved, and the sarcomatous nature is recognised by the microscope and by the great tendency of the growth to recur even after apparently complete removal; on account of this latter feature, the name of 'recurrent fibroid tumour' (Paget) was formerly applied to it. The recurrences generally take place at gradually diminishing intervals, and the tumour may then become softer and more vascular; occasionally the tendency to recur seems to wear itself out after the performance of several operations.

The **Treatment** of sarcoma mammæ consists in the removal of the entire organ at as early a date as possible, together with the axillary glands.

Cancer of the Breast.

No organ of the body, with the exception of the uterus, is more frequently the seat of cancer than the female breast; it also occurs in the male subject, but is about a hundred times less common than in the other sex.

Ætiology.—The breast is an organ subject to great changes in functional activity, richly supplied with blood, and closely associated by nervous connections with other organs of the body, especially the uterus. At the climacteric its functions are at an end, and as it always undergoes a certain amount of fibrosis or degeneration, it can be readily understood that changes are very likely to ensue which may result in the formation of a cancerous tumour. Such is usually met with after the age of forty, although the disease may prove fatal at a much earlier date. It equally affects women who have borne children and nulliparæ, and the question whether or not the woman has nursed her children seems to have but little influence. The left breast is more often affected than the right. It is frequently attri-

buted to some injury, such as a blow or squeeze; whilst there is little doubt that badly-fitting stays are responsible for a certain percentage of the cases. It not uncommonly follows eczema of the nipple, especially that variety known as Paget's eczema; chronic interstitial mastitis may also possibly be an occasional precursor of this affection. The question as to heredity is one exceedingly difficult to decide, and, although it may be a marked feature of some cases, it is somewhat doubtful whether, as a general rule, it has any considerable influence.

Two distinct types of cancer are met with in the breast—viz., acinous or glandular cancer (including the acute form, and the more chronic type known as scirrhus) and duct cancer. Colloid degeneration of either of the former varieties has been observed, but is very uncommon.

1. **Acinous Cancer** includes the great majority of cases; the division into scirrhus and acute cancer depends clinically on the rate of growth, pathologically on the greater or less amount of fibrous stroma present in any particular case.

Scirrhus usually commences as a hard circumscribed mass, situated most commonly in the upper and outer quadrant of the organ. It is closely united to, if not absolutely incorporated with, the breast substance, and on careful digital examination its margin is not so accurately defined as at first appears. In the early stages it is entirely distinct from the skin, which moves freely over its surface; but as growth proceeds, the stroma contracts, and, by dragging on the suspensory ligaments of Cooper passing from the mamma to the skin, the latter structure becomes more or less fixed and hence, on attempting to move it upon the tumour, an appearance of dimpling results. At the same time, the whole breast is acted upon in a similar manner, so that the affected organ sometimes seems to be smaller than the other; and, since the upper half of the gland is usually affected, the nipple may be drawn up so as to lie at a higher level than its fellow, as well as being retracted from the drag of the growth on the galactophorous ducts (Fig. 349). The tumour itself is rarely one of great size, so long as it retains its scirrhous nature; it is sometimes extremely painful and tender, but not uncommonly the pain is intermittent, and of a neuralgic type, extending to the shoulder, and perhaps only elicited on manipulation. As the growth increases in size, it becomes adherent to the pectoral fascia, and may even infiltrate the underlying muscular substance, so that, on examination, with the arm extended and abducted, it is found that, although moveable across the fibres of the muscles, the breast cannot be moved with them.

The *lymphatic glands* in the axilla soon become enlarged, the disease rarely lasting many months without this complication. Those running with the long thoracic vessels under cover of the pectoralis major are first involved, and, as the case progresses, the remaining axillary and subscapular sets become similarly affected, and even after a time the supraclavicular. When the inner or deeper part

of the breast is attacked, the disease may spread to the mediastinal glands along the lymphatics, which accompany the nutrient vessels arising from the internal mammary trunk; and thus intrathoracic deposits develop, which even extend along the subpleural connective tissue, and affect the pleural cavity and lungs. In those cases where the primary growth is situated near the inner border of the breast, the free lymphatic anastomosis across the middle line allows of the transmission of the disease to the glands in the opposite axilla, and sometimes a similar affection of the opposite breast arises from this cause.

The *skin* may be implicated in many ways. (*a*) We have already mentioned the dimpling which is met with over the tumour in the

FIG. 349.—SCIRRHUS MAMMÆ. (FROM A PHOTOGRAPH.)

The patient had allowed the tumour to grow for two years. The whole of the right breast was infiltrated and raised above the level of the other organ; the nipple was retracted. Just above the nipple was a cancerous nodule in the skin, and the lineæ albicantes due to previous functional enlargement were hyperæmic and infiltrated.

early stages. As the case proceeds, the cancer extends outwards along the suspensory bands of fascia, so that the skin itself becomes invaded, feeling firm and brawny, and looking congested and purplish in colour, whilst a branny desquamation is usually present. A crack or fissure at length forms, giving exit to a little serous discharge, which at first scabs over, but finally leaves an ulcerated surface, which slowly extends, and may attain considerable dimensions. A typical *scirrhous ulcer* is hollowed out and excavated; its surface, if kept clean, is covered with smooth granulations, discharging a con-

siderable amount of sanious fluid, but if neglected, it becomes sloughy and offensive; it is surrounded by a projecting elevation of the tumour substance, forming a sort of rampart around it. (*b*) Less commonly the disease becomes disseminated through the skin, giving rise to a series of dusky-red, button-like masses of cancer, surrounded by skin which is often apparently unaffected; or the whole cutaneous surface of the organ may become infiltrated and thickened, constituting the condition known as cancer *en cuirasse*. In the earlier stages the skin is thickened and firmer than usual; but the mouths of the sebaceous glands are enlarged and very evident, giving it a coarse appearance like 'pig-skin,' or the rind of an orange (*peau d'orange* of French authors). Later the colour becomes dusky, and the skin so contracted and indurated that it is impossible to wrinkle it; the sebaceous glands may exude an abundant secretion, which becomes inspissated on the surface into crusts or scabs, which are independent of any ulceration. This process often extends widely beyond the limits of the breast, invading the whole thoracic wall, and even running over the shoulder to the back of the head or neck; it is due to a diffuse extension of the disease along the cutaneous lymphatics, and in its most typical form is slow in its development, the patient perhaps living for many years. Localized buttons or nodules of cancer are often found scattered through the affected area. (*c*) Occasionally one meets with a much more rapid form of cancerous lymphangitis, in which the skin becomes similarly affected, but the growth is not unfrequently associated with what is supposed to be a 'weeping' eczema, due in reality to the yielding of dilated lymphatics, that can be easily seen on examining with a lens. The process spreads widely and rapidly, and cancerous nodules appear here and there in the infiltrated area; the prognosis is, of course, very grave.

In the later stages, the patient passes into a state of cachexia, becoming emaciated and exhausted. Ulcerated surfaces of considerable size may exist, and the tumour is fixed to the thoracic wall, even invading the ribs. The arm on the affected side is swollen and brawny, owing to the pressure of the enlarged glands on the main lymphatics and veins of the limb, constituting a condition of lymphatic or solid œdema. Secondary deposits also develop in the viscera, especially the pleura, lungs, and liver, and may lead to various symptoms. Not unfrequently recurrence takes place in the lymphatics of the connective tissue between the rib cartilages and the pleura, and these nodules of growth may project forwards through one of the intercostal spaces (usually the second). Deposits in the bones are also not unusual, the sternum, vertebræ, and femora being perhaps most often affected. Finally, death from exhaustion ends the scene.

Acute Cancer is fortunately not common, and appears as a somewhat soft, rapidly-growing tumour, which quickly infiltrates the whole organ, and gives rise to secondary lymphatic and visceral affections at a much earlier date than scirrhus. It does not cause retraction of the nipple or dimpling of the skin, the latter structure

being distended, and with blue veins coursing under it. The breast becomes enlarged and prominent, the skin is gradually invaded by the tumour, and if ulceration follows, a foul fungating mass sooner or later sprouts up through the opening. This variety usually attacks young women under thirty-five years of age, and runs a rapidly destructive course, especially if it occurs during pregnancy or lactation.

Finally, in elderly women, a chronic form of cancer is met with, known as **Atrophic Scirrhus** (Fig. 350), in which the disease lasts for many years without much definite extension. Cases have been known to persist for fifteen or twenty years, the patient at length dying of some intercurrent malady, although in the great majority

FIG. 350.—ATROPHIC CANCER OF BOTH BREASTS. (FROM A PHOTOGRAPH.)

The nipples are both retracted, and the skin around puckered and fixed to the growth. On the right side the axillary glands are obviously enlarged.

dissemination has ultimately occurred. The special characters are due to the excessive contraction of the stroma, as a result of which the cellular elements become crushed, and practically destroyed. The nipple is deeply retracted, and the tumour and breast substance in the most marked cases are scarcely discernible.

2. **Duct Cancer** is a somewhat rare form of the disease, the exact nature of which is still under discussion, and there is very little doubt that several distinct types have been described under this name. It is sometimes characterized by the development of one or more nodules

of a malignant papillomatous nature within the dilated ducts, and usually situated not far from the nipple. These growths are covered with columnar epithelium, and may, indeed, be looked upon as forms of columnar cancer. They are exceedingly vascular, and a blood-stained discharge from the nipple is usual. They always grow slowly, and when situated near the skin give rise to a round dusky-red swelling. The nipple is not retracted, and lymphatic enlargement not constant. In other cases the dilated alveoli are occupied by masses of proliferated epithelial cells of a spheroidal type, which arrange themselves into more or less definite papillomatous growths, whilst cystic degeneration also occurs. Either of these varieties may be associated with a development of ordinary scirrhus in some other part of the breast. The diagnosis can only be established with certainty by microscopic examination after removal.

Adeno-carcinoma is the term given by Halsted to a condition very similar to the latter variety of duct cancer. The growth consists of tubular spaces heavily lined with epithelium; it develops slowly, but frequently fungates through the skin, and presents as a localized pedunculated growth, which readily bleeds. The axillary glands are usually free from infection, and the prognosis is good.

The **duration** of cancer varies considerably in the different forms. The encephaloid type runs a rapid course, and will probably destroy the patient's life in six to twelve months. Duct cancer is very slightly malignant, whilst atrophic scirrhus is similarly slow in growth, and in both death may be postponed for a considerable period, or is often due to some intercurrent malady. Cancer *en cuirasse* is variable in its course, being sometimes tolerably rapid, and at others chronic; it cannot be cured by operation on account of its early and extensive dissemination. A circumscribed scirrhous tumour is stated to end fatally, on an average, in two or three years if no operative treatment is undertaken, whilst removal of the mass will probably add another year or eighteen months to the patient's life. These figures are, however, derived from statistics of operations performed before the general adoption of the more exact and extensive measures which are now usually undertaken, and it is likely that they considerably under-estimate the benefits derived from such interference.

The **Pathological Anatomy** of cancer is discussed at p. 206.

The **Diagnosis** of scirrhus from *chronic interstitial mastitis* and *chronic abscess* or *cyst* has been already considered (p. 941). From *tumours of the adenoid type* it is easily distinguished. The stony hardness of a scirrhus, its union with the breast substance, its limited mobility, the dimpling of the skin, retraction of the nipple, and enlargement of the axillary glands, are the chief local characteristics to be noted. Non-malignant tumours are more elastic to the touch, more movable, and usually quite circumscribed in outline, whilst the skin, though expanded, does not become adherent; the nipple is rarely retracted, and the axillary glands remain of normal size. It is often impossible to distinguish a cancerous from a *sarcomatous tumour*, except on microscopic examination; a round-celled sarcoma closely resembles an

acute cancer, although it is usually more circumscribed—at any rate, in the early stages. A *fibro-sarcoma* may sometimes be mistaken for scirrhus, but it is more defined in outline, does not cause retraction of the nipple or dimpling of the skin, whilst lymphatic enlargement is not a constant accompaniment. A *cysto-adenoma* presents no difficulty in diagnosis if the skin is entire, and the cysts prominent; but when ulceration has taken place, and a fungating bleeding mass protrudes, it is not unlike the later stage of an encephaloid cancer or fungating round-celled sarcoma. It can be distinguished, however, by the fact that a probe can sometimes be passed under the skin for some distance into the cavity of the cyst, whilst lymphatic enlargement is rare.

Treatment.—This necessarily consists in the removal of the tumour by operation in all cases where there seems a reasonable chance of eradicating the disease. The only conditions that would contra-indicate operation are extensive adhesions to the thoracic walls, the presence of visceral deposits, and extensive diffusion of a rapidly-growing acute cancer in a young subject. Atrophic scirrhus is often left alone, on the plea that the prognosis is so favourable as to render operation unnecessary; if, however, the patient is fairly strong, there is no objection to it, and it certainly seems wise to remove a cancerous focus, however chronic it be. Disease of both breasts, although rendering the prognosis more grave, is, *cæteris paribus*, no hindrance, since both organs have been removed successfully, even at one operation. Speaking generally, rapidly-growing tumours in vigorous patients are very unfavourable cases to deal with, whilst slow growth of the tumour, and definite limitation of its outline, are favourable signs.

A full description of the operation is given below, but we desire here to emphasize the fact that the proceeding should be very radical if the patient is to derive any real benefit from it. In the old days, only the more prominent portion of the breast was removed with the tumour, and consequently recurrence was so extremely common that if 5 or 10 per cent. of the patients were really cured, it was thought to be as much as any surgeon could reasonably expect. Since we have learnt more of the anatomy of the organ and of the pathogenesis of the disease (for which we are mainly indebted to Heidenhain and Stiles), more extensive proceedings have been undertaken, with a gradual amelioration in the results, so that several surgeons have been able to report 50 to 60 per cent. of their cases as free from recurrence at the end of three years. It was suggested by Volkmann that any case that remains free from recurrence for three years may be claimed as a cure, but this is generally considered too short a period on which to base such an assumption, since experience tells us that the disease often reappears at a much later date (even nine or ten years).

The breast has been demonstrated to be a much more extensive organ than was formerly supposed, its lobules extending upwards nearly as high as the clavicle, outwards into the axilla, and for some

distance downwards, so that removal merely of the prominent part of the gland may leave much behind, and thereby favour recurrence. Moreover, it has been shown that the deeper lymphatics pass into the fascia covering the pectoralis major, and so to the axilla; hence, this structure should always be taken away, as well as a thin layer of the muscular fibres, but the wiser course to adopt is to remove the whole of the sternal portion of the pectoralis major, leaving only the clavicular. Many surgeons also remove the pectoralis minor muscle; this procedure certainly favours the axillary dissection, and does not seem to have any harmful influence on the subsequent movements of the arm. Again, lymphatics travel along the fibrous bands reaching from the breast tissue to the overlying skin, and thus this latter must never be dissected back from over the tumour. The nipple should under no circumstances be left behind, since all the interlobular lymphatics converge to a plexus around it, and thence pass to the axilla by three or four main trunks. The axilla itself should be opened in every case, and entirely cleared of its lymphatic contents, since deposits in the glands are often found on microscopic examination, where no clinical evidence of their presence had been previously noted. It is also important to remove the breast and axillary tissues in one piece, so as to avoid division of the lymphatics and possible infection of the wound with their cancerous contents.

Operation for Cancer.—The patient lies on the back, with the head directed towards the opposite side, and the arm raised to a little more than a right angle, so as to put the pectoralis on the stretch. An aseptic towel should be wrapped round the head, so as to keep the hair out of the way, and a similar sterilized towel may be placed below the chin, to form a barrier between the anæsthetist with his apparatus and the field of operation. The axilla should be previously shaved, and the skin carefully purified. The incisions employed vary with the size and position of the tumour, one great essential being that the whole of the projecting portion of the breast with its integumental covering should be removed, and that no part of the skin which lies immediately over the tumour should be dissected back and left. The primary object is to remove the growth together with the gland and all its ramifications; the question of being able to close the wound subsequently is quite a secondary and minor consideration. As a rule, sufficiently wide undercutting will allow even the most extensive wounds to be closed; but when this is impossible, skin-grafting at the time or subsequently can be adopted, and no lengthy convalescence need ensue. Figs. 351 and 352 suggest the types of incision that may serve for the removal of tumours on the outer and inner sides of the breast respectively. Slight modifications will suggest themselves when the growth is in other positions.

When the incisions have been made, they are deepened, but not directly inwards. The skin around is dissected up so that the subcutaneous connective tissue may be removed together with the breast over a wide area extending as high as the clavicle above

own to the epigastric notch below, and behind the posterior border f the axilla on the outer side. The surface of the pectoralis major s then exposed throughout the whole length of the inner or upper ncision, the connective tissue over it being turned downwards. The unction between the sternal and clavicular portions is defined, and pened up by finger and knife throughout its whole length. The nsertion of the sternal portion is divided about an inch from the humerus, and then the finger is introduced under its origin from the sternum and costal cartilages, and this is severed by the knife close to the bone. Several perforating branches of the internal mammary will be divided in this procedure, and must be at once secured, so as to prevent their retraction through the intercostal spaces. The

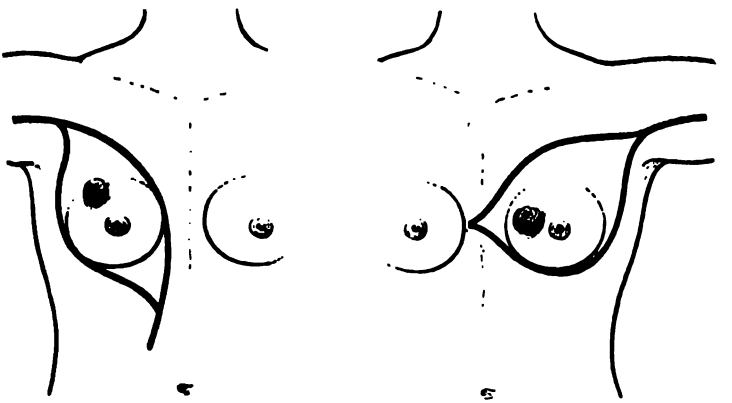

FIG. 351. FIG. 352.

FIGS. 351 AND 352.—INCISIONS FOR REMOVAL OF CANCEROUS BREAST WHEN THE TUMOUR IS SITUATED IN THE UPPER AND OUTER, OR IN THE INNER SEGMENT RESPECTIVELY.

ectoralis minor now comes into view, and is divided at its costal ttachments and also close to the coracoid process.

The breast and underlying tissues can now be drawn downwards and utwards, thereby opening up the axilla freely; the next step consists n thoroughly clearing it. The main vessels are first defined below the ower border of the pectoralis minor close to the outer angle of the round; a layer of fascia needs division in order to accomplish this. The dissection is then carried inwards along the vessels and nerves, which are freed from fat and glands both in front and behind, if necessary. Arterial and venous branches are best secured by ligature before division. If the glands are closely adherent to the vein, it is wise to excise a portion of it rather than to attempt to peel them off. The most careful search for glands must be made in the apex of the axilla, and in removing them every effort must be used not to rupture the glands by careless handling, as thereby dissemination of cancer cells might occur.

The surgeon next proceeds to clear the fat and fascia from the serratus magnus on the inner side of the wound, care being taken to secure the lateral branches of the intercostal arteries as they are divided, and to protect the nerve of Bell. The subscapularis is then cleared, and possibly the subscapular vessels may need division, but the subscapular nerves must be spared. Not unfrequently there are many enlarged lymphatic glands in this part of the axilla. When this has been effected, but little more remains to be done except to free the breast, pectorals, and connective tissue from their external attachments, and this is quickly accomplished by a few sweeps of the knife.

An enormous wound results from this operation, and during the later stages the exposed tissues must be protected as far as possible by covering them with sterilized cloths. It may also be desirable to wash the wound over from time to time with hot sterilized salt solution. Bleeding points are now secured, and preparations made for closing the wound. Surrounding parts may need to be extensively undermined, or even plastic proceedings carried out in order to bring forwards redundant skin from the side and back. As a general rule the wound can be more or less completely closed by the exercise of a little patience and ingenuity. Should it have to be left open, it is probably wise to defer a grafting operation till later. Deep tension stitches are often useful, and the margins of the wound are approximated by ordinary catgut or silk sutures. Drainage is usually desirable, and the tube may be placed through an opening made for it in the posterior axillary wall. A large and efficient dressing is applied back and front to receive the sero-sanguineous discharge, which is sure to be abundant. The arm is left at right angles to the side throughout the healing with the object of preventing the subsequent stiffness and limitation of movement, which was so marked formerly when the arm was bandaged to the side. The first dressing will be required in thirty-six or forty-eight hours, and the drainage-tube may then be removed. Healing should be complete in from ten to twelve days.

The immediate results of this operation are exceedingly satisfactory, the mortality being under 5 per cent. The ultimate results necessarily vary with the period at which the operation was undertaken, with the extent and character of the disease, and with the thoroughness and skill of the operator.

In a few early cases a somewhat less severe operation may be justifiable, the modification consisting in the non-removal of the pectoral muscles. The whole of the breast and of the skin over it must, however, be taken away, as well as the fascia over the pectoral muscle, and the axilla must be thoroughly cleared.

When the supraclavicular glands are enlarged, the operation must also include the supraclavicular fossa in its scope, as recommended by Halsted; he, indeed, goes so far as to maintain that the posterior triangle should be cleared of its lymphatic contents in all cases, whether or not enlarged glands can be detected beforehand, and states that in a

considerable percentage cancerous invasion will have already occurred. The cervical incision is a curved one, extending along the posterior border of the sterno-mastoid, and outwards along the clavicle. This flap is dissected up, and all the fat and glands are removed from before backwards, the internal jugular vein being the starting-point. Of course, the greatest care is taken to avoid the thoracic duct or right lymphatic trunk. Some surgeons go so far as to divide the clavicle, but this seems to be a needless proceeding. The axillary and the supraclavicular wounds can easily be made continuous under the clavicle. In the majority of cases, however, the cervical operation will probably be secondary, and undertaken for recurrence.

Local recurrence after operation is always due to incomplete removal of the growth, or to infection of the wound during the operation. The operator must ever keep in mind that although in a healthy organism the implantation of cancerous material has apparently but little or no effect, yet in a cancerous individual positive results are only too certainly obtained. The recurrence appears either in the neighbourhood of the cicatrix, the most usual situation, or in adjacent lymphatic glands, in the other breast, or in the retrocostal connective tissue. The progress is often slow, but occasionally the disease spreads more rapidly than if no operation had been undertaken. Another attempt should always be made to remove the growth, if such be feasible.

Diffuse cancer of the skin (*en cuirasse*) is not suitable for operative treatment, but much may be done by exposure to the X rays (p. 210) or by radium.

Some years back Beatson of Glasgow proposed to treat inoperable cases by double oöphorectomy and the administration of thyroid extract. Many patients have been dealt with in this way, and the results gained thus far show that a few cases have been apparently cured, in a much larger number no effect was produced, but that in quite an appreciable proportion the disease seems to have been temporarily controlled (perhaps for years), and the pain and discomfort very definitely diminished. Probably the thyroid extract does no good, and the results are to be ascribed to the oöphorectomy. The operation should only be undertaken in women who have not yet reached the climacteric, but if they fully understand what it involves, we consider it justifiable. We have certainly seen it followed by retrogression of growths and diminution or cessation of pain, which are not usual in the course of an inoperable recurrent scirrhus.

Amputation of the Breast for *non-malignant* conditions is a very different operation to that described above. The incisions usually employed are crescentic and placed obliquely; they need not include much more skin than that indicated by the breadth of the areola. The integument is dissected up from the glandular tissue on either side, and the organ freed from its attachments to the pectoral fascia; the axilla is frequently not opened.

CHAPTER XXXIV

ABDOMINAL SURGER

General Remarks on Abdominal Operations.— rare occurrence, and perhaps this was as well frequently followed. At the present time hesitates to open the abdomen whenever requ from preventable causes has been steadily c toneum, which formerly the surgeon dreaded his best friends, if properly treated. Attentic essential if good results are to be obtained, a few points which may prove of service to t in this important branch of work.

The patient should be carefully *prepare* permit, by regulating the diet and bowels for so that the intestinal canal may be as fr possible ; a course of internal antiseptics, or β-naphthol, may be advisable. The abdo also the pubes and vulva, and thoroughly the usual way. Especial care is directed t dirt is very liable to lodge. On the night purgative is given, *e.g.*, 1 ounce of castor oi desirable in the morning to ensure that the lo

No food should be allowed by mouth for diately before being placed on the table emptied. If the proceedings are likely to be p to give a rectal injection of warm saline solu brandy, half an hour beforehand, and possibly of strychnine (gr. $\frac{1}{100}$).

The patient should be warmly wrapped cold, no unnecessary exposure being allowe desirable, so as to diminish shock. Intrape not painless, for although the visceral peri sensitive, yet the parietal layer is, as well mesenteries, and any handling of these struct and necessarily to increased shock, if the pati

As a general rule the patient is lying flat operation involves the pelvic viscera, the

advisably adopted. In it the patient is placed with the head considerably below the rest of the body, which is more or less inverted (Fig. 353). The knees are bent over the end of the table, and help to keep the body in position. The headpiece of the table must be lowered, or the neck will be bent forwards into a position that much impedes respiration. The arms must not be kept above the head, or musculo-spiral paralysis may follow; they are best placed behind the patient's back. This position must never be adopted in conditions where obstruction is present, and the stomach is likely to be filled with offensive material which might gravitate into the mouth and suffocate the patient.

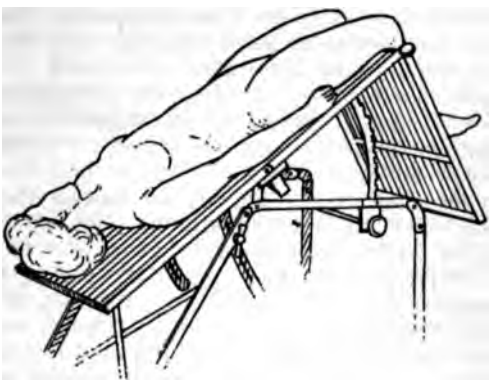

FIG. 353.—TRENDELENBURG'S POSITION FOR PELVIC OPERATIONS.

Antiseptics should be avoided as far as possible in intra-peritoneal operations; after efficient sterilization of the hands of the surgeon and his assistants and of the skin of the patient, nothing is employed in the shape of lotion except sterilized salt solution. Instruments are boiled previously and counted. Sponges are carefully purified beforehand, and wrung out in salt solution; they are counted before and after operation. Swabs are best done up in packets of a dozen, wrapped up in gauze; it is thus easy to keep account of the number employed. Gauze strips for packing, abdominal cloths, etc., are dealt with in the same way, and the assistant and nurses must make a careful mental record of the number employed. If any irrigation of the abdomen is required, warm salt solution is the best lotion to use for the purpose.

Parietal Incision.—Formerly, whenever practicable, the incision was made in the middle line through the linea alba, in consequence of the facts that there is less bleeding in this situation, that all parts of the abdomen are easily accessible from it, and that the wound is more rapidly closed. It has been found, however, that ventral hernia is a not uncommon sequela, and hence, although the median incision is still largely retained on account of its convenience, and especially in septic cases that need to be drained, it has been discarded in many situations, and incisions have been planned going through more vascular structures. Even in such operations as ovariotomy, where the middle line gives the best access, it is wise to go through the rectus a little to one side of the centre rather than through the linea

alba itself. The linea semilunaris, again, is a bad situation for an incision, since the traction of the muscles which are inserted into its outer side is so great that hernia is very likely to follow. On the other hand, care must be exercised not to place the incisions too near the bony margins of the abdominal cavity, or subsequent manipulations may be hampered by the rigidity of one side of the wound.

The muscles should be cleanly divided, and it is wise to see that all bleeding is stopped before opening the peritoneum. Directors are best avoided, since they are very likely to wound the serous membrane, and are quite unnecessary in skilled hands. A small hole should be first made in the peritoneum, through which a blunt-nosed pair of forceps is inserted, and by lifting these up and allowing the blades to separate slightly, a convenient and safe substitute for a director is obtained. If a long incision is needed, the left index and middle fingers are passed through this opening; the intestines and omentum are thus kept out of the way, the peritoneum being well raised and divided by scissors to the required extent.

Several ingenious methods of opening the abdomen have been suggested of recent years, with the idea of minimizing the chances of subsequent ventral hernia. It must ever be remembered that the method of opening the abdomen is every whit as important as that of closing the incision; above all, it is desirable that the motor nerves of the abdominal parietes should be respected. *McBurney's muscle-splitting* method is largely adopted in removing a quiescent appendix (p. 1042); it gives a sufficient approach when there are no adhesions, and the appendix is not displaced; but should these conditions not be present, or if the patient is very stout, it will prove most inconvenient. It may also be used in iliac colotomy. *Lennander's trap-door* incision consists in opening the sheath of the rectus in front, displacing the muscle in or out, and then making the incision in the posterior layer of the sheath and through the peritoneum so as not to correspond too closely to that in front. The replacement of the rectus constitutes an extra barrier to the prevention of hernia.

The intestines must be most carefully guarded during the intraperitoneal portion of the operation, as if they are unduly exposed to the air, the endothelial lining is quickly shed, and adhesions may form from without, whilst bacterial invasion may be predisposed to from within. If they have to be withdrawn from the abdomen, they must be wrapped up in cloths wrung out of warm salt solution, and it is the assistant's duty either to replace these from time to time by warm cloths, or to keep them moist and warm by pouring fresh salt solution over them; no unnecessary handling of intestine is permitted. If any infective focus is to be opened, or the intestine incised, the surrounding parts must be carefully protected from infection by 'walling off' the area of operation; this is effected by introducing boiled abdominal cloths (made of soft calico, and about 16 inches square) or strips of white sterilized gauze wrung out of warm salt solution all round the wound, especially in directions where pus or

ther fluids might gravitate. A careful record of these must be kept, ınd it is wise not to cut any of them into smaller pieces.

Closure of the Wound.—A careful toilette of the peritoneum must ›e undertaken before the abdomen is closed. All bleeding is stopped ınd blood-clot removed; sponges are counted, and, if there has been ıny extravasation of infective material, it is well to wash the site of ›peration with sterilized salt solution at a temperature of about ıo8° F., a proceeding which often assists considerably in minimizing shock. Many different methods of closing the parietal incision have been adopted, but perhaps the best consists in firstly securing the peritoneum by a continuous catgut stitch; then the muscular coats are approximated by deep interrupted stitches either of purified silk or of silkworm gut, which remain buried; and finally the skin is united by means of a continuous suture, which is subsequently removed.

Drainage is not usually called for in abdominal operations. If the surgeon is careful in his manipulations, and avoids measures which are likely to lead to subsequent oozing, the peritoneum may be closed with safety. Where an inflammatory focus has been opened, or when adhesions likely to bleed have been divided, or raw surfaces left such as occur after enucleating a parovarian cyst from the broad ligament, some means should be provided whereby any considerable effusion of fluid can escape. It is found that capillary drainage along a strip of gauze is the best that can be employed for blood or serum. Ordinary indiarubber tubes are liable to become blocked by portions of the intestine protruding into the lateral openings, whilst glass tubes, such as Keith's, are unyielding, and fail to accommodate themselves to the sinuosities of the regions needing drainage. Strips aseptic gauze are therefore inserted like lampwicks, and along se, by capillary action, the effusion finds its way into the general ssing placed over the wound. Of course a certain amount of esive inflammation follows, and therefore the wick should be as ll as possible, consistent with efficiency, and is changed or oved at the end of forty-eight hours. In some cases it is an ntage to enclose the gauze-wick in gutta-percha tissue which has previously perforated here and there. Where, however, pus is removed, an ordinary drainage-tube must be employed.

ter-Treatment.—After the completion of the operation, the ıt is replaced in bed, with the head low. If restless and ›le, a small dose of morphia may be administered, but the less ıtter, since it induces intestinal paresis, and this in turn assists ial invasion from the gut. No food is allowed to enter the :h for twenty-four hours, although the mouth may be washed th warm water or with still lemonade, and nutrient enemata stered every four or six hours. The great essential is to vomiting, and this is best accomplished by a complete ary cessation of stomach-feeding. At the end of twenty-four f all is going well, a little fluid nourishment is given, and this ually increased. Of course, special directions as to feeding

are required when the stomach itself has been incised. The bowels may be opened by castor oil on the third day unless there is any special necessity for keeping them quiet for a longer period.

Not uncommonly there is a good deal of discomfort and abdominal distension for the first few days. This is usually due to a collection of flatus which the patient is unable to pass. The introduction of a flatus tube may succeed in giving relief; failing this, a turpentine enema may be administered. If peritonitis is threatening, the patient complains of abdominal pain and distension, whilst flatulence and vomiting are distressing symptoms (*peritonism*). Under these circumstances the administration of a saline purgative (*e.g.*, 20 grains of sulphate of soda every half-hour) may stop the process by re-establishing peristalsis, removing bacteria and their products, and lessening the vascular tension. Should these measures fail, the outlook is grave; in some cases it may be justifiable to reopen the abdomen, wash out, and drain.

Stitch suppuration is a troublesome and irritating sequela of abdominal operations. It may be due to faulty technique, but occurs quite apart from this. The most careful sterilization of suture material will not always prevent its occurrence, and then it must be attributed either to tying the suture too tightly and strangling the tissue within its grasp, to auto-infection of this strangled tissue, or of some collection of blood around it. The trouble may start early or late, and its occurrence is not unfrequently indicated by a slight but persistent rise of temperature (say, to 100° every night). The external wound may apparently heal perfectly, and then ten or twelve days after the operation the cicatrix yields, and a quantity of pus may escape. Under these circumstances efficient drainage should be arranged, and if need be the exposed stitches must be removed. Of course, this process weakens the abdominal wall, and extra precautions must be taken to prevent the formation of a ventral hernia.

Intestinal Sutures.—The interior of the bowel is occupied by material which, as long as it remains in its proper place, is innocuous enough; but should it find its way into the peritoneal cavity, an acute and often fatal peritonitis is almost certain to follow. Hence every union made by the surgeon must be air- and water-tight, and capable of accommodating itself to varying degrees of intra-intestinal pressure. For this reason a continuous stitch is seldom employed except in the long axis of the bowel, or when there is some button or bobbin within it. Again, it is essential that on its peritoneal aspect the line of union should present nothing but serous membrane, as otherwise adhesions are certain to form, and the comfortable action of the bowel will be subsequently impaired. Hence, special forms of stitches have to be adopted, the more important of which are described below.

Lembert's Suture, originally proposed at the end of the eighteenth century, has for its object the bringing of surfaces of peritoneum together without encroaching on the mucous membrane; any stitch which involves the whole thickness of the wall is liable to be followed

by leakage of the intestinal contents, and possibly by peritonitis. The needle is passed at right angles to the axis of the wound through a small fold of the serous and muscular coats, going down to the submucosa; each fold is placed about $\frac{1}{12}$ inch from the margins of the incision (Fig. 354). On drawing up and tightening the stitch, the margins of the wound are tucked in (Fig. 355), and only the serous

FIG. 354.—LEMBERT'S SUTURE AS APPLIED FOR A LONGITUDINAL WOUND OF THE BOWEL.

The stitches are carried well beyond the extremities of the incision, so as to obliterate the groove always caused by this method of suturing.

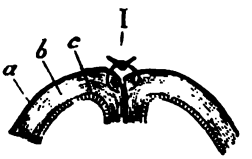

FIG. 355.—LEMBERT'S SUTURE SEEN IN SECTION, TO SHOW CHARACTER OF APPROXIMATION.

I., Suture; *a*, serosa; *b*, muscularis; *c*, mucosa.

coats brought into apposition. A series of similar stitches are inserted along the whole extent of the wound, numbering about ten or twelve to the inch, or it may be carried on as a continuous stitch. In closing a longitudinal incision in this way, a groove will be formed at either end which must be obliterated by two or three extra sutures. For a small puncture the same type of stitch is utilized, but it may be introduced circularly around the opening like a purse-

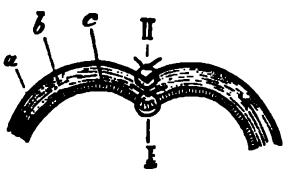

FIG. 356.—CZERNY-LEMBERT SUTURE.

I., Stitch securing divided mucous membrane; II., ordinary Lembert suture, for the serous coats; *a*, serosa; *b*, muscularis; *c*, mucosa.

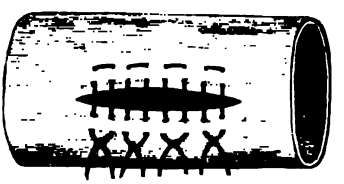

FIG. 357.—HALSTED'S MATTRESS SUTURE.

string, and by tightening it the margins of the aperture are turned in and buried.

The *Czerny-Lembert Suture* is very similar in its nature, but consists of two rows: the first has for its object the closure of the wound in the mucous membrane (Fig. 356, I.), and in a longitudinal wound this may be of the continuous type; the second row consists of the ordinary Lembert stitches, continued or interrupted according to the requirements of the case (Fig. 356, II.). By this means the

knots of the first series of sutures are c
second row.

Halsted's Mattress Suture (Fig. 357)
constantly utilized. It consists pract
loop bei
whilst tl
It is i
same p
Lembert
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segment
together
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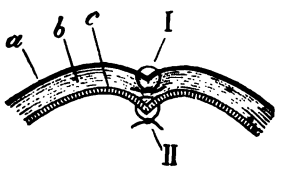

FIG. 358.—WÖLFLER'S SUTURE.

I., Stitch through serous and muscular coat applied and tied from within; II., stitch uniting divided mucous membrane over the former, so as to cover it in; *a*, serosa; *b*, muscularis; *c*, mucosa.

Wölfler's
first passed through the serous and
(I.), the knots being tied on the inner
of the open gut. The mucous membr
row of stitches (II.), so as to cover ov
some cases of intestinal anastomosis

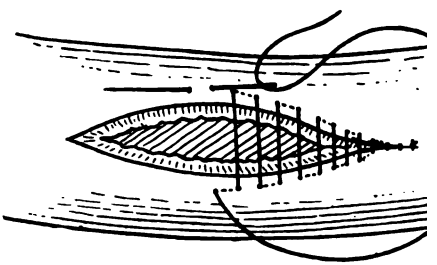

FIG. 359.—CUSHING'S RIGHT-ANGLED SUTU
UNITING THE SERO-MUSCULAR COATS O
STOMACH OR INTESTINE.

ing to the usual Lembert method,
a continuous Lembert suture, except
parallel to the margins of the wound
$\frac{1}{8}$ inch from it, instead of at right
thereby tucked in very neatly. Of
is first dealt with separately by some
may be employed very advantageousl
similar procedure.

Injuries of the Abdominal Wall.

These may be divided into three main classes—contusions, non-penetrating and penetrating wounds; but, of course, the most important point about them is as to whether or not visceral complications are present.

Simple Contusions of the abdominal parietes differ but little from those of any other region of the body. Any form of lesion, from a slight bruise to an extensive muscular laceration, may be included in this category. The rectus is the muscle most often involved, and its laceration may result not only from injury, but also as a consequence of sudden and forcible contractions, *e.g.*, in tetanus. Blood is extravasated between or under the muscles, and a well-marked hæmatoma may follow. In connection with the rectus the hæmorrhage may be limited by the lineæ transversæ if it only involves the anterior aspect, but may diffuse itself widely through the sheath if the back of the muscle is torn. All abdominal hæmatomata are very liable to suppurate, the abscess either pointing locally or burrowing widely between the muscular planes, and coming to the surface at some weak spot, *e.g.*, Petit's triangle or the external abdominal ring. The pus is usually redolent of the *B. coli*, suggesting that the organism found its way into the extravasated blood from some damaged coil of intestine in the neighbourhood. Occasionally the parietal peritoneum is torn, causing shock and intraperitoneal extravasation of blood. In almost all cases of abdominal contusion shock is a marked symptom, but in the absence of visceral lesions it is neither severe nor prolonged.

Treatment consists in keeping the patient in bed until the tenderness and pain have disappeared. Shock is dealt with in the usual way, and fomentations or a firm compress of dry hot wool will give much comforting support. Rupture of the rectus muscles necessitates the adoption of the sitting position, with the knees flexed over pillows; at a later date support, as by strapping or a well-fitting abdominal belt, will be required.

Non-Penetrating Wounds of the Abdominal Wall have no special significance, and if uncomplicated by visceral lesions are treated on general principles. If the epigastric artery is divided, extensive extravasation is likely to ensue; the wound must then be enlarged, and the bleeding points secured. If the abdominal muscles are widely divided, steps should be taken, after thorough purification, to draw together the severed muscular or aponeurotic fibres by deep stitches, so as to diminish the tendency to a ventral hernia.

Penetrating Wounds of the Abdominal Wall may occur with or without injury or protrusion of the abdominal viscera. In all cases there is a certain amount of hæmorrhage, greater or less according to the size of the vessels divided, and of shock, which latter is very marked when the viscera are injured, whilst mere protrusion without injury may cause but little effect. Thus, cases are on record in which a patient has walked to the surgeon for treatment, supporting

some coils of intestine in his hands. The pr
small intestine or omentum, are often larg
with the size of the opening, causing them
gested, or even strangled. Necessarily, in a
is that of diffuse septic peritonitis, caused
intestine or by infection from without. We
the fact that the peritoneum which covers t
sensation of pain, whilst the parietal perito
the mesentery are very sensitive; on the c
peritoneum is much more liable to bacillary

Treatment.—The external wound is ca
protruding viscera are similarly purified. I
it is wise to ligature and remove it, whet
Intestine should be carefully washed with
with weak antiseptic lotions, such as boric
(1 in 4,000), and then replaced; if slightly br
but the external wound should not be entire
wick of gauze is inserted, so that if bacillary
vasation occurs subsequently, a ready exit is p
or punctures must be sutured, but when sm
damaged, enterectomy should be undertaker
condition is sufficiently good; otherwise it
dominal wall, and a temporary artificial anus
intestine, this latter course is required more
cases where the bowel is loaded with fæces
fixed in the wound as in colostomy, and th
subsequent period.

In cases where it is not certain wheth
been implicated, the surgeon should always
to make sure, and if the serous membrane
should carry his investigations still further, a
whether any damage had been done to the

The external wound must (with the exce
be carefully closed with sutures, so as to
subsequent ventral hernia. The peritoneu
are united by buried stitches of catgut or we
the skin is brought together with a continuo
may need to be inserted for a time.

Visceral Complications are likely to be asso
the abdominal wall, and may transform it int
import. The liability to visceral injury vari
the violence, and with the condition of the al
subjacent viscera. If the blow is slight, t
not serious, and the patient merely suffers
tusion with some amount of shock. If the
the muscles are rigid, but little harm may
violence is great; but when the abdominal
blow unexpected, a slight injury may do m
viscera, such as the stomach, intestine, or

and when distended they are more liable to such an accident. Solid viscera, such as the liver, spleen, or kidneys, may be bruised or torn, and grave hæmorrhage may result therefrom; a soft fatty condition of the organs, especially of the liver, may predispose to such a lesion. Displacement of organs may sometimes occur, and it must not be forgotten that any sudden sharp concussion, especially if directed to the epigastrium, is liable to be followed by severe shock from irritation of the subjacent solar plexus of the sympathetic nerves, and life itself may be destroyed in this way by syncope without the appearance of an evident lesion.

The clinical history of these injuries will be described under the various organs, and only a few general statements need be made here. It is obvious that a serious responsibility rests upon the medical attendant in any case of abdominal injury, and that the gravest results may follow a mistaken conclusion as to the nature of the lesion, or a hesitant policy in undertaking operation. In a large proportion of cases abdominal injuries, even including rupture of intestine, are amenable to operative treatment, if only it is performed sufficiently early; if, however, operation is delayed until the gut is paralyzed and peritonitis well established, death is almost certain to ensue whether operation is undertaken or not. Unfortunately, no absolute rules can be laid down as to when operation is necessary, but the surgeon should remember that exploration in a doubtful case will probably do far less harm than delaying operation until the diagnosis is made certain by an outbreak of diffuse inflammation, providing always that the patient is not so profoundly collapsed as to contra-indicate all interference.

Cases of serious abdominal injury group themselves into three sets: (1) Where, in addition to a localized lesion of the parietes, there is severe shock due to contusion of viscera, but with no justification for laparotomy; (2) where there is serious intraperitoneal hæmorrhage, as from a ruptured liver or spleen, or a tear of the mesentery; and (3) where a hollow viscus is opened, and peritonitis is at once lighted up.

Shock is almost always well marked in abdominal lesions, but unless there is a serious wound of some viscus, it usually passes off in less than twenty-four hours if the patient is left quietly in bed. *Intraperitoneal hæmorrhage* causes various symptoms according to its amount and site of origin; in addition to the initial shock, the general signs characteristic of this condition show themselves, viz., pallor, restlessness, 'air-hunger,' and possibly the large-waved hæmorrhagic pulse. Dulness may be noted in one or both flanks, according to the situation of the lesion, being influenced by the attachment of the mesentery; thus blood from the liver may gravitate into and for a time be limited to the right lumbar region and iliac fossa without reaching the pelvic cavity; blood from the spleen will pass freely down into the pelvis along the left side of the mesentery, producing dulness in the left loin and not in the right. When the bleeding is less severe, the patient complains of a severe

tearing pain, becomes pallid and anæmic, but
blood be absorbed; not unfrequently the ter
the initial shock has passed, and remains up f
from absorption of fibrin ferment. The onset
by persistence of the collapse, and the onset o
whilst the abdomen becomes distended, its wa
and the breathing becomes thoracic; probably
mum tenderness will be noted, especially when

Treatment.—The patient having been put
shock combated in the usual way, a most
the patient and his abdomen is instituted.
immediate operation are: (*a*) well-marked i
rhage; (*b*) blood-stained vomiting, indicati
stomach; and (*c*) the phenomena due to a rup
such circumstances, no delay is justifiable, an
is present, operation should be commenced, u
imminent. A large intravenous injection of
usually rally the patient sufficiently to warra
ceeding, whilst freely washing out the perit
same hot solution has often a similar effect. I
shock is present, with perhaps localized pain
evidence of visceral lesions, expectant treatm
The patient is kept warm in bed; perhaps a
tered to allay pain and restlessness and to
little as possible should be given, since symp
masked thereby. If there is any vomitin
should be employed after the lower bowel has
the manifestations of intraperitoneal hæmorrh
themselves evident, or if at the end of not
hours the patient is still, more or less, in a
and especially if he complains of a fixed ter
contracted abdominal wall over it, or if vor
supervened, then operation can still be underta
of success.

There are but few other conditions of the
require notice. The rectus muscle may be to
or tetanic convulsions, and a hernia is very li
the segments may become spasmodically
what is known as a 'phantom tumour,' usually
females, and disappearing under an anæsthet

Affections of the Umbilic

The various forms of umbilical hernia are d

Inflammation and **Ulceration**, perhaps runn
arise from want of cleanliness after separatior
neonatorum probably owes its infection to t
erysipelas of infants, both of which diseases
whilst the latter is often accompanied by slou

ing abdominal parietes. The eczematous condition merely requires cleanliness, and the application either of an antiseptic dusting-powder or of some simple ointment.

Occasionally a **Polypoid Excrescence** is met with growing from the umbilicus, and is probably derived from the remains of the umbilical vesicle. On microscopic examination, it is found to consist of a number of tubular glands held together by connective tissue. All that is required is to ligature the base and cut it away.

Warts and **Nævi** are also found here, but need no special notice, as also syphilitic and cancerous disease. The latter is either an epithelioma, starting in the skin as a result of prolonged irritation, or a columnar carcinoma, which may arise primarily in some fœtal relic or be secondary to an intra-abdominal focus.

Umbilical Fistulæ not unfrequently occur, and may be congenital or acquired. Three varieties are described:

(*a*) A *Fæcal Fistula* of congenital origin arises from non-closure of the vitello-intestinal duct, and either opens into the intestine directly, or by means of a passage of greater or less length, which corresponds to Meckel's diverticulum, and is connected with the lower part of the ileum. Sometimes this passage is closed at the intestinal end, and then only discharges mucus. Acquired cases are usually due to perforation of the bowel following strangulation of an umbilical hernia, or to tuberculous peritonitis.

(*b*) A *Congenital Urinary Fistula* is due to non-closure of the urachus; occasionally merely a sinus persists, leading towards the bladder, but not opening into it. It may be dealt with by excision of the mucous membrane, its destruction by the galvano-cautery, or by freshening the edges and subsequent suture.

(*c*) A *Biliary Fistula* sometimes forms at the umbilicus, resulting from an abscess connected with the gall-bladder.

In **Ectopia Vesicæ** the umbilicus is absent, the extroverted portion of the bladder extending up to what should normally be its situation.

Affections of the Peritoneum.

Peritonitis arises from many different conditions and presents many different manifestations. It may be acute or chronic in its course, localized or diffuse in its distribution, and protective or rapidly destructive in its results.

Ætiology.—Peritonitis is almost invariably due to the action of micro-organisms, and the symptoms largely depend on the toxæmia determined thereby. The bacteria light up an inflammatory reaction characterized by effusion of varying type; in the mildest forms it is usually abundant and localized, in the severer types it is generalized, and in the worst cases death may ensue from toxæmia before there has been time for the development of marked anatomical changes.

1. Infection may start from any part of the intestinal canal or its adnexa included in the abdomen, from stomach to rectum. It may be due to traumatic or pathological rupture or perforation, to the

extension outwards of ulcers, to the impact
the damaging influence of interference with
strangulation, volvulus, etc. The vermifor
monest site of onset of this group of cases.
and *B. coli* are the organisms most frequ
of the other inhabitants of the intestine, e
anaërobic, are occasionally causative. On
contents are less noxious than those of the
contents of the small gut are more liable to b
do more harm than the more solid fæces in t

2. A somewhat similar type of origin ca
the organisms (usually streptococci, but
extending from the uterus through the ly
ligament, etc., to the peritoneum; it is th
mischief to limit itself to the pelvic viscera.

3. Infection may occur from without, as
operations, etc., any of the ordinary pyo
responsible. In this connection we would
alluded to more than once, viz., that the
depends largely on the peritoneum remain
Rough handling and prolonged exposure are
the surface endothelium and diminish its resi
same conditions check the power of absor
permit of bacterial growth.

4. Peritonitis may be due to the *gonococcu*
spread up the Fallopian tube; to the *pneu*
blood infection, or secondary to pneumonia
travelling through the lymphatics of the diap
the organism of *acute rheumatism*, then, p
appendix.

5. The *B. tuberculosis* is responsible for the d
tuberculous peritonitis.

6. Simple chronic peritonitis is of a p
arises when any irritative lesion of a viscus
peritoneal surface, which becomes thickened
sions of various types may result from this
velopments (obstruction, strangulation, etc.) n

7. A group of cases occurs in which
mechanical or chemical in the first place, *e.*
from a ruptured gall-bladder, or the irritati
of a wandering spleen, of an ovarian cyst, or
Severe reaction follows such a lesion, but it i
may be shut off from the general cavity by p
thereby encapsuled or absorbed; or the inf
to neighbouring coils of intestine, and wh
paralyzed bacterial invasion is almost certa
peritonitis to ensue.

It is interesting to note that a localized imm
in the peritoneal cavity of animals by injecti

doses of toxic material; it is probable that a similar condition obtains in man, and this explains why the sites of old peritonitic trouble are often favourable for operations, an attack of generalized inflammation being unusual.

Varieties.—From a purely clinical standpoint, peritonitis may be discussed under two main headings—the acute and the chronic. The acute is again divided into the diffuse and localized, and the chronic into the simple and the tuberculous.

1. **Acute Diffuse Peritonitis** results from infection of the peritoneal cavity with a large dose of septic material (as by rupture of the stomach or intestine), or by the introduction of a small dose of virulent organisms when the resisting powers are low.

Pathological Anatomy.—The peritoneal surface becomes congested and a little sticky, and its shiny appearance is lost as a result of the proliferation of the endothelial cells and a commencing œdema of the subserous connective tissues; this change is most advanced in the neighbourhood of the site of infection, but rapidly spreads, and in the gravest forms of peritoneal toxæmia, where death takes place under twenty-four hours, there is but little other evidence of the disease. In the great majority of cases, however, effusion occurs; sometimes the fibrinous element is most marked, the intestines being matted together, and the fibrin thickest along the lines of contact of adjacent coils; sometimes there is an abundant serous exudation, but more frequently it is sero-purulent or consists simply of pus, and then gravitates to the loins and pelvis, or may be shut up in pockets by the development of adhesions. The effusion is intensely infective, and the surgeon may wisely protect his hands by rubber gloves, since any wounds caused during operation or in the post-mortem examination are likely to be followed by severe cellulitis or even septicæmia. Gas may be present, resulting either from decomposition of the exudation or from penetration of an air-containing viscus.

The contents of the gut stagnate and undergo decomposition. The omentum becomes congested and infiltrated with effusion, or even pus; it may occasionally, however, form a barrier across the abdomen, shutting off the lower from the upper part, and thus limiting the mischief to one or other section.

Symptoms.—The onset varies somewhat with the cause of the affection; but when due to traumatic infection from without, the symptoms usually commence with abdominal pain and distension, together with flatulence and vomiting. The pain may at first be localized to some particular region, or referred to the umbilicus; soon, however, it becomes diffuse, and is associated with exquisite tenderness and great distension. In a typical case the phenomena are very characteristic. The patient lies on his back with the knees drawn up, partly to relax the abdominal muscles, partly to prevent the bedclothes touching the body. The abdomen is distended, hard, and extremely tender; it is at first generally tympanitic, but later on, if effusion should become marked, dulness may be noted in the flanks, although this is not a common feature. The pulse is quick,

In the later stages, however, when the patient is suffering from severe toxæmia, when the intestines are distended and paralyzed, and when fæcal vomiting is present, it is quite a question whether operation is desirable, and whether the necessarily fatal issue will not be hastened rather than hindered. In such cases, if operation be undertaken at all, it should be limited to a small incision under cocaine anæsthesia in the middle line below the umbilicus, and the introduction of a glass or rubber drainage-tube, or of a strip of gauze, in order to remove the fluid exudate. A larger opening will involve the escape of distended and paralyzed intestines, and to return these even after puncture and removal of the contained gas is often a matter of serious difficulty. It is also probable that complete disinfection of the cavity will be impossible, and the results hitherto gained have been so bad that many surgeons doubt the desirability of operating at all in such hopeless cases.

Apart from the question of operation, the patient is fed *per rectum*, and strychnine administered as a cardiac stimulant. Great relief is gained by washing out the stomach, thereby getting rid of all the foul, decomposing contents.

In the less severe earlier cases operation is certainly the correct treatment, and if not left till too late good results may be anticipated, as in the treatment of perforated gastric ulcer. Details will be given more fully in dealing with the various viscera, but a few general facts may be mentioned here.

The incision is usually made in the linea alba and below the umbilicus, unless there is some definite indication that the causative lesion is in the upper part of the abdomen. The effusion has then to be removed, the intestines cleansed, and the cause dealt with. This last indication is discussed elsewhere. The practice of various surgeons differs as to the best way of cleansing the peritoneum. Some consider *irrigation* the best plan, using salt solution at a temperature of about 107° F. for the purpose. It is usually advisable to make counter-openings and insert a large drainage-tube in each loin if this is undertaken, and Douglas's pouch must be well washed out and drained. Others maintain that mopping up the effusion with dry sterile swabs and employing no fluid to wash it with is the better practice, and certainly excellent results can be pointed to. Probably both methods are right in certain cases. Where the effusion is localized and not diffuse, as is so common, the dry method is certainly desirable. Irrigation would be only too likely to disseminate the mischief. When, however, there is much generalized effusion, as in some cases of perforated gastric ulcer, irrigation may be wisely undertaken. Another question arises as to the desirability or not of *evisceration*, and the complete and thorough cleansing of all the coils of intestine under a stream of hot salt solution. There can be no question that this procedure seriously adds to the shock of operation, and except in very favourable and special cases we do not consider it advisable. Drainage is necessary in almost all cases, and may be effected by glass or rubber tubes with or without gauze wicks

(p. 963). The importance of overcoming tl
so great that it has been suggested by McCo
a saturated solution of Epsom salts should b
part of the jejunum before closing the ab
sound, and the practical results that have
satisfactory.

In cases of threatening peritonitis followir
as indicated by pain, distension, and vomiti
causative factor is often a paralytic condi
permits of the retention and decomposition c
thus assisting the activity of the *B. coli.*
saline purgative (*e.g.*, sodii sulphas, gr. xx.-
useful, in order to free the intestine from
When, however, general septic peritonitis is
only do harm.

2. **Acute Localized Peritonitis** usually a
some limited lesion of the abdominal cont
nature as to permit of the general peritone
by adhesions, the process being thereby lo
followed by suppuration, the abscess bei
although not involving the general peritonea
arising in connection with appendicitis or
uncommonly of this nature. They may bur
adhesions, and thus light up a diffuse inflam
sac, or they may burrow to the surface and
into one of the hollow viscera.

The **Symptoms** complained of are deep pa
or less localized to the affected area, togeth
and constipation. At first no swelling or t
but a feeling of resistance may be noticed
which is held tense and rigid, as if guard
mischief. As the effusion increases in am
tympanitic on percussion may become evide
matting together of the intestines and omentu
with a variable amount of effusion; if, how
the dulness may be absent owing to the fixa
of intestine in front of the inflammatory foc
and travels towards the surface, the abdon
trated, red, and œdematous, the component
the touch, and cutting like bacon. Fin
presents itself in the midst of this indurate
either discharges itself or is opened. The p
be thin and offensive, or it may be free from
somewhat inspissated, and like custard in
this process is attended with considerable i
constitutional disturbance. If the cavity is
rapidly contracts and a cure is accomplished,
adhesions may persist and lead to trouble
the intestinal movements. If a communica

the intestine, a fæcal fistula is apt to follow; whilst if the cavity becomes septic, chronic suppuration may result, and thereby the patient's health and strength are undermined. The determination as to the existence or not of suppuration in these cases is by no means easy, and a blood count is often of the greatest value (see p. 48).

Treatment.—In these cases, resolution can be obtained in favourable cases by keeping the patient quiet and on a low diet, with perhaps a little morphia, and by applying fomentations locally, whilst the lower bowel is emptied by an enema. Such a course must, however, not be persisted in for too long when suppuration is likely to have occurred, for fear of the inflammation spreading to the general peritoneal cavity, or of the abscess bursting into it. An early exploratory laparotomy is advisable under such circumstances. The line of treatment marked out for appendicitis (p. 1041) is that which should always be followed.

3. **Simple Chronic Peritonitis** in itself rarely requires surgical attention, since it is to be looked on rather as a protective than as a destructive process. It is characterized by infiltration and thickening of the peritoneum, giving rise to adhesions, whereby the intestinal wall is strengthened and bacterial invasion hindered. It is localized or diffuse in character, and arises as the result of some pre-existing inflammation. In the more diffuse forms it is due to a cured septic or tuberculous peritonitis, and then the intestines may be hopelessly matted together, or the omentum rolled up and contracted into a rounded cord-like mass, lying transversely across the upper part of the abdomen; chronic obstruction is almost certain to arise sooner or later from this condition.

More frequently it is the consequence of some localized injury or inflammation. In the former plastic lymph is deposited over any breach of continuity of the serous membrane, and to this the omentum or intestine becomes adherent; the under surface of a laparotomy wound is not unfrequently affected in this way. Localized areas of inflammation are similarly liable to originate adhesions, which are thus found in connection with gastric ulcers, an inflamed vermiform appendix, enlarged mesenteric glands, or pyosalpinx. Under favouring circumstances many such adhesions are absorbed in the early stages; but if they persist they are modified by the intestinal movements, and are likely to become lengthened and rounded, thus originating the bands and cord-like structures so often the causes of acute obstruction. The anatomical arrangements of the omentum explain why this structure is so frequently involved in this process, and thereby it constitutes one of the most important agents for checking the spread of inflammatory affections. Intestinal adhesions often give rise to no symptoms; but sometimes they determine attacks of colic and of irregular peristalsis, and occasionally an adhesion to the abdominal wall (*e.g.*, one springing from the stomach) causes a localized constant pain which justifies exploration.

4. **Tuberculous Peritonitis.** — This disease is almost limited to young people, and is usually secondary to some other focus of tuber-

culosis, *e.g.*, in the intestine, mesenteric glands, Fallopian tube, testis, etc. It is sometimes limited in its development to a portion of the peritoneal cavity, especially when originating from the pelvis or vermiform appendix, but is more frequently diffuse. It manifests itself in several different ways, which may be associated with or follow one another: (1) In the *ascitic* variety the peritoneum becomes thick and hyperæmic, and is studded over with tubercles, some of them small, gray and translucent, others larger and undergoing caseation. The effusion is generally abundant, and consists of straw-coloured or opalescent serum, perhaps blood-stained in the more active cases. Flakes of fibrin may be found covering the membrane here and there, but there is no extensive matting of the intestines. Occasionally the effusion becomes encapsuled, giving rise to cystic swellings shut in between the coils of intestine. (2) In the *fibrous* variety the intestines become matted together by extensive adhesions, and between them foci of tubercle are found. The mesentery may become infiltrated and shrink, fixing the intestines back *en bloc* to the posterior abdominal wall. The omentum is often invaded, and contracts upwards to form a sausage-like tumour lying transversely above the umbilicus. There is but little effusion, and that is usually encapsuled. It is obvious that such a condition is very likely to lead to obstructive phenomena due to kinking of the intestine. (3) The *ulcerous* variety is characterized by an exaggeration of the above phenomena. Tuberculous foci of some size are found between the coils of intestine; caseation and suppuration follow, and the abscesses are likely either to open into the intestine, possibly into two coils, causing thereby a fistulous communication, or perhaps to travel to the surface and open externally, and then most frequently at the umbilicus, possibly giving rise to a fæcal fistula.

In each of these varieties acute manifestations may develop at any time as a result of infection from the bowel with the *B. coli*, and then the symptoms of acute diffuse peritonitis may supervene.

The **Symptoms** are extremely variable, and the early stages of the disease are sometimes not easy to recognise.

A few cases have an *acute* onset with abdominal pain and distension, and continued pyrexia which may suggest the existence of enteric fever. The abdominal wall, however, is not rigid; the tenderness is not great; there is well-marked evidence of free fluid, and though vomiting and constipation may be present, they are not marked features. Naturally the patient in such a condition wastes quickly.

In the more *chronic* forms the earliest symptoms are weakness with some slight abdominal discomfort, and not uncommonly diarrhœa, alternating, perhaps, with constipation. The temperature becomes of a hectic type, and periods of improvement may alternate with attacks of increasing pain and weakness. On the whole, the patient gradually gets worse, his wasted frame comparing markedly with the protuberant and enlarged belly. The phenomena discoverable on abdominal palpation vary considerably with the conditions present within.

Treatment in the early stages is often successfully undertaken by

the physician. Hygienic measures are adopted, the patient living in the fresh air, and, of course, being always in the recumbent position. Plenty of good digestible food is given, as also cod-liver oli and perhaps intestinal antiseptics, such as salol, creasote, etc. The external application to the abdomen of iodine, either as a paint or an ointment, is much commended by some physicians. Should the condition undergo no improvement, it may be justifiable to operate. When marked ascitic accumulation is present, all that is needed is to remove the fluid and close the wound with or without irrigation, and in nearly 75 per cent. of the cases a cure may be anticipated. In the acute forms, however, infection of the wound may follow the escape of the highly infective fluid from the peritoneal cavity, and healing may be thereby delayed. Where diffuse or localized suppuration is present, adhesions which can be reached may be gently broken down, exit given to the pus, and the peritoneal cavity washed out; but no prolonged search after suppurating foci should be made, or the intestine may be torn. The results of treatment in this variety are not nearly as satisfactory as in the former, at least 40 per cent. of the cases dying. As to the way in which cure is established, opinions differ, some authorities considering that it is due merely to the admission of atmospheric air, some to the alteration produced thereby in the intra-abdominal tension, whilst others maintain that it is simply in consequence of the removal of the exudation and its contained toxins. The most plausible idea, however, attributes it to a flushing of the intra-abdominal tissues with blood plasma (a well-ascertained fact after laparotomy) and the effect of the antitoxic substances contained therein, the tubercles thereby having their vitality destroyed. In this connection one may note the statement that too early a laparotomy does but little good, an insufficient amount of antitoxin having presumably developed in the system.

Subphrenic Abscess is the term applied somewhat loosely to a suppurating focus which is in more or less intimate relation with the under surface of the diaphragm. Two main varieties are described, viz., the intraperitoneal, which is much the more common, and the retro- or extra-peritoneal. The *causes* are very diverse, and the manifestations vary somewhat with the causative lesion. 1. The *stomach* is the most frequent source of the trouble, the infection being due to the extension of a chronic ulcer. If the *anterior wall* is involved, the pus will be limited by the lesser omentum and stomach behind, by the diaphragm and left lobe of the liver above, by the falciform ligament on the right, and by adhesions between the stomach or omentum and anterior abdominal wall below. This type of abscess usually points to the left of the ensiform appendix. Should the ulcer be situated on the anterior wall near to the fundus, the abscess may get into close relationship with the spleen, and point beneath the left costal margin. When the abscess arises in relation with the *posterior wall*, the lesser sac of the peritoneum may be filled with pus, which is prevented from escaping from the foramen of Winslow by adhesions, whilst the stomach itself is pushed forwards, and the pus travels up and

presents above it to the left of the middl
sac has been previously obliterated, and
retroperitoneal tissues. 2. Ulcer of th
very similar conditions. If the abscess i
by the liver, colon, omentum, and anteri
ally it has also tracked up behind the
puration also occurs in connection with
travelling up between the liver and diap
the loin. 3. The *appendix vermiformis* i
abscess, the pus burrowing behind the p
along the inner or outer walls of the asc
be caused by extension of suppuration f
or from retroperitoneal structures, such
bræ. According to Fenwick, however
subphrenic abscess are due to ulceratior

The abscess thus induced may cont
gas, which is derived either from a di
bowel, or from the activity of the *B. col*
being present. It was to this condition
the name of *subphrenic pyo-pneumothorax.*
along the under surface of the diaphragı
being displaced considerably upwards, a
the pleura, either by lymphatic absorp
actual solution of continuity. The effe
pus into the base of the pleural cavity,
empyema.

The **Symptoms** vary considerably. Th
referable to the causative lesion, and th
gradual. Ordinary febrile phenomena
rigors, may occur, whilst the patient co
part of the abdomen, together with vom
pain is often increased on respiratory
upwards to the shoulder. On palpatio
one or other side are held rigidly contra
either dull or tympanitic according to
There may be some bulging of the inte
side the diaphragm may be pushed up, a
if the abscess contains gas, an area of
noted between the dulness of the live
lung. On the left side, the heart may
with the diaphragm, and the absence o
heart is an important diagnostic featu
pneumothorax. The X rays will someti
displacement upwards of the diaphra
affected half. A blood count is importa
of suppuration.

The **Treatment** consists in opening
wherever it is most accessible. In man
through the anterior abdominal wall al

ribs, but even then a counter-opening is often needed behind. When the abscess does not project anteriorly, the best situation for an opening is through the pleural cavity, as for some abscesses of the liver. The incision lies behind the mid-axillary line, a portion of the eighth or ninth rib being excised. If, as often happens, there is also an empyema, this is opened and drained, and then an additional opening can be made through the diaphragm if one does not already exist; if, however, the pleural cavity is not affected, the serous membrane covering the upper surface of the diaphragm must be stitched to the parietal pleura before the diaphragm is incised.

Ascites.—By this term is meant an accumulation of fluid, and that usually of a serous type, within the peritoneal cavity. It results chiefly from lesions which fall to the care of the physician—viz., cirrhosis of the liver, chronic Bright's disease, and various cardiac affections. It is also a consequence of any obstructive pressure on the portal vein, as by malignant glands in the portal fissure secondary to carcinoma of the stomach or of the intestine, or by fibrous adhesions, the consequence of duodenal ulceration or stones in the gall-bladder. Fluid also collects in the abdomen as the result of diffuse malignant deposits scattered over the peritoneum, or from the presence of mildly irritative foci, such as hydatid cysts, etc. *Chylous* ascites is a condition in which the fluid is milky from an admixture of chyle, and usually results from rupture of the receptaculum chyli in consequence of the pressure on the thoracic duct above it of malignant glands secondary to cancer of the stomach. *Encysted* ascites results from the distension of a portion of the cavity which has been shut off by inflammatory adhesions.

The **Physical Conditions** resulting from ascites are easy of recognition. The abdomen is distended, like a barrel, but with bulging flanks. Dulness is present in the loins when the patient is recumbent, and extends forwards to about the same level all round, the only resonant area being about the umbilicus; this is due to the floating forward of the intestines. On rolling the patient over to one side, the dull and resonant areas shift, the part that is highest becoming resonant. This sign is occasionally absent if the mesentery is short or if the intestines are tied down posteriorly. On tapping the abdomen, a well-marked thrill is usually transmitted from one side to the other. Necessarily, the fluid also finds its way into any diverticula of the peritoneum, such as an unclosed funicular process or a hernial sac. The **diagnosis** of ascites should present no difficulty, but the practitioner must not be satisfied until he has found the cause of its presence, and this may not be easy even when the fluid has been removed, so that the abdominal viscera are palpable.

Treatment necessarily varies with the cause of the accumulation. Should it persist, and the patient's breathing be hampered by the abdominal distension, removal by *paracentesis* is essential. The usual plan adopted is to seat the patient on a chair and to encircle the abdomen with a flannel binder, the ends of which are split to within 6 inches of the middle line. The unslit portion is placed over the

abdominal wall in front, whilst the divided portions cross behind, and are held by assistants, so as to make continuous pressure upon the abdominal contents. The bladder is completely emptied, and then the abdomen is carefully percussed, and a spot of absolute dulness selected; here a small skin incision is made with a scalpel, and a suitable trocar and cannula inserted. The median line below the umbilicus is the place usually chosen for the puncture, but there is no objection to inserting the trocar through the flanks. Some surgeons prefer to withdraw the fluid more slowly, so as to prevent the shock often experienced from its rapid removal. Two or three Southey's trocars and cannulæ may then be inserted.

Not unfrequently the fluid re-accumulates, and the process has to be repeated after a time. When the cause of the collection is doubtful, the practitioner will take the opportunity of the lax abdominal wall to palpate the viscera; light may also be thrown on an obscure case by a cytological examination of the fluid. In malignant disease, cancer cells and blood may often be found. If the condition is still doubtful, an exploratory laparotomy may be advisable.

In cases due to hepatic cirrhosis, Talma's operation of **Epiplopexy** may possibly be justifiable. The object is to relieve the obstruction to the portal system by opening up fresh communications between it and the systemic veins. The method consists in fixing the great omentum to the abdominal wall and determining the formation of adhesions; necessarily the peritoneum has to be drained and kept dry during this procedure, and the question arises as to whether this drainage is not the cause of the improvement. The mortality is not inconsiderable, especially when the liver is small: the best results have been gained with hypertrophic cirrhosis. The method is still on its trial, but appears to be justifiable in suitable cases.

Affections of the Great Omentum.

The omentum is of great surgical importance in the abdomen, in that it covers in and protects the viscera, and by its mobility is able to apply itself to many a weak spot where perforation or infection might occur, and thereby protect the patient from serious inflammatory mischief. The result of this protection is, however, the formation of adhesions which by the irritation of constant movement may stretch and become rounded and cord-like, and various forms of intestinal obstruction (by strangulation, kinking, etc.) may result therefrom. The value of this protective power of the omentum is recognised by surgeons in the employment of *omental grafts* to add security to a line of junction in the intestinal wall with which they are not quite satisfied. It is only occasionally that such a provision is required. The best method to adopt is to detach the graft entirely from its former connections, wrap it round the gut, and stitch it in place.

The omentum may be torn, and holes may be formed in it as a result of injury. The immediate symptoms would be pain, shock, and the phenomena of intraperitoneal hæmorrhage; but it is likely that

other injuries co-exist. At a later date the hole might determine an attack of internal strangulation.

Acute Inflammation (epiploitis) has been lighted up as a result of the application to the omentum in a hernia operation of a septic ligature. The phenomena vary with the virulence of the organisms, an acute diffuse peritonitis perhaps resulting. In the milder forms a localized inflammatory disturbance follows, with all the phenomena of a limited peritonitis; suppuration may ensue, and a large intraperitoneal collection of pus may result.

Torsion of the omentum is an occasional complication of an irreducible hernia, and that usually on the right side. The lesion generally follows some heavy strain, and results in venous stasis, effusion of a blood-stained fluid, the formation of extensive adhesions, and possibly gangrene and general peritonitis, if left long enough. The symptoms often start abruptly with colicky pain in the right iliac fossa and scrotum, together with constipation and sickness; the hernial swelling becomes enlarged, and extending upwards from the iliac region a sensitive mass may be detected on palpation, which is dull on percussion, and sometimes reaches to the epigastrium. The temperature is normal, though the pulse-rate is accelerated. Treatment is obviously operative, and consists in removal of the omentum.

Chronic peritonitis, whether simple or tuberculous, may cause the omentum to be rolled up into a more or less solid mass, which lies transversely across the abdomen a little above the umbilicus. There is usually a band of clear resonance between it and the hepatic dulness, which is of great diagnostic importance.

The omentum also becomes infiltrated with secondary cancerous nodules, which can not unfrequently be palpated, and their presence gives important indications as to the desirability or not of operative treatment. Colloid degeneration is not uncommon in omental cancers, and huge masses of this growth have been sometimes discovered in the deadhouse. Omental carcinoma usually leads to a considerable effusion of fluid into the peritoneal sac.

Affections of the Mesentery.

Wounds result from penetrating or non-penetrating injuries. They are usually associated with laceration of the intestine, and the resulting phenomena will be those of hæmorrhage, followed by general peritonitis from the intestinal lesion. Pure mesenteric wounds not involving the intestine are usually due to penetrating or gunshot injuries. Hæmorrhage to a varying degree may result, and if the patient lives the nutrition of the intestine may be seriously endangered. If such a lesion is found on exploration, bleeding points must be secured and the opening in the mesentery closed; before this is accomplished, however, careful consideration must be given to the vascular supply of the intestine, as the ligature of a main branch of a mesenteric artery may determine gangrene, and necessitate resection of a portion of the bowel.

may grow to a large size, and destroy life by its pressure phenomena; the latter, though sometimes resembling the former in structure, invades surrounding tissues earlier. The diagnosis is uncertain until the abdomen is opened, and the question of removal is dependent on the relation of the growth to the mesenteric vessels, which must not be injured. It is seldom that a retro-peritoneal sarcoma can be enucleated.

Affections of the Stomach.

Rupture of the Stomach results from blows or falls upon the epigastrium, especially after a heavy meal, and then usually involves the pyloric end or the greater curvature near the cardiac orifice. It may also follow a penetrating injury, such as a stab or a fall upon a spike or railings. Neighbouring viscera are not unfrequently involved in the lesion, especially the liver or spleen.

The **Symptoms** are those of severe and prolonged shock, with epigastric pain and vomiting, the ejected material often containing blood; acute septic peritonitis usually ensues in a very short time, destroying the patient's life in a few days. Occasionally, when the wound is small, or the organ empty at the time of the accident, there is but little or no extravasation, and then a localized intraperitoneal abscess may form, shut off from the general peritoneal cavity by adhesions, and sooner or later bursting and discharging into the stomach, colon, or one of the hollow viscera, or else coming to the surface and bursting externally; sometimes the barrier of adhesions will give way, and a late general peritonitis may result. If the posterior wall of the stomach is alone injured, the resulting phenomena are very similar to those due to the perforation of an ulcer in this region (*q.v.*).

Treatment.—No time must be lost in undertaking a laparotomy when the diagnosis is tolerably certain, since the only hope of saving the patient's life lies in early interference. A median incision is made above the umbilicus, the situation of the injury in the stomach ascertained, and the aperture clamped by forceps so as to prevent any further exit of the gastric contents whilst the peritoneum is being cleansed. All extravasated material should be carefully sponged or swabbed away, and if the general cavity has not yet become inflamed, irrigation should be avoided for fear of carrying infective material to other regions. The wound in the stomach is closed by a row of Lembert's sutures, which tuck the margins inwards, and these must extend a little beyond the lesion on either side (Figs. 354 and 355). If the posterior wall is also injured, as by a bullet wound, an opening should be made through the omentum so as to explore and cleanse the lesser sac of the peritoneum. If the case has been operated on early and there is but little peritoneal inflammation, it may be possible to close the parietal wound entirely; but, as a rule, it is necessary to drain the upper part of the serous cavity by inserting a plug of gauze down to and around the site of the injury. If the general cavity is inflamed, the treatment suitable to acute peritonitis must be instituted (p. 975). It will probably be

wise under these circumstances to place a dr
above the symphysis pubis, reaching down
well as making counter-openings in the loin
incision partly open.

Foreign Bodies in the stomach consist eitl
been swallowed accidentally or intentionall
hairs, wool, etc., due to the constant ingestio
remain in the viscus, and may after a time f
presence of the former is known from the
may give rise to symptoms of gastric irritati
inexplicable until the mass has attained suc
presence of a tumour. The only treatmen
body of any size is to open the organ and
where, however, it is of small dimensions,
allowed to pass onwards.

Ulcer of the Stomach is an exceedingly co
quences of which are often very serious,
being associated with it, its complications, or
types may be mentioned here, although othe

(*a*) The **acute** ulcer is rarely larger tha
'develops with almost equal frequency at
cardia and the pylorus along the upper mar
more frequently on the posterior than on the
wick). It is not unusually multiple, two u
exactly opposite one another, suggesting ar
trouble. They are of a circular shape, and
defined and clearly cut; each successive coa
degree than the one internal to it, so that
funnel-shaped. Should perforation occur, th
but slightly to one side. These acute ulcers
culty, as is evident from the number of radi
the post-mortem table. They give rise to no
when they are situated within the pyloric orif
this variety is not uncommon, but is rarely f

(*b*) The **chronic** ulcer may attain considera
many square inches of each surface being
single, and situated on the posterior wall
which may be involved in the trouble by
very variable, though in the earlier stages it
tant type is the horseshoe ulcer, which sp
surface from the lesser curvature, and may
hour-glass contraction of the organ. The
hard, and infiltrated, whilst the gastric wal
sclerosed. In old-standing cases there may
tion of tissue, external viscera, such as the
times exposed in the wound. Hæmorrhage

* See Fenwick, 'Ulcer of the Stomach and Duo
1900; and Mayo Robson and Moynihan, 'Diseases
Surgical Treatment,' Baillière, Tindall and Cox, 190

may prove fatal; one of the larger branches of the coronary artery, or perhaps the splenic, is then involved, or the bleeding may arise from one of the enlarged varicose gastric veins which are often found in the neighbourhood of an old ulcer. Perigastric inflammation of an adhesive or suppurative type is almost certain to occur, and cicatricial contraction of various forms is likely to follow.

Women are much more liable to gastric ulcer than men, in the proportion of three to one; but it is the acute variety to which they are most prone, and from which, apart from perforation, they seldom die. The usual age of such patients is from fifteen to thirty years. Men, on the other hand, are more liable to chronic ulcers, and though acute perforation is less common, they are subject to a number of serious complications which may prove fatal. Their average age when attacked is from thirty to fifty years.

Into the ætiology, general symptoms, and routine treatment of gastric ulcers it is unnecessary to enter; they are sufficiently described in medical text-books. A number of complications, however, arise which may require surgical assistance, whilst it must be remembered that the mere persistence of symptoms may justify operative measures, especially since the observation has been made and confirmed that malignant disease may commence on the site of an old-standing ulcer.

1. **Excessive and Persistent Hæmorrhage** is responsible for quite a considerable proportion of the deaths from gastric ulcer. It may arise from arteries, veins, or capillaries, and at first it is difficult to say from what source it is derived. Inasmuch, however, as in over 90 per cent. of the cases it can be stopped by medical means, it is obvious that the capillary origin is most common. It is uncommon for the patient to succumb to the first attack of bleeding, and hence the rule of practice which is usually adopted, viz., to treat the first acute hæmorrhage by medical means; but should it recur or persist unduly, surgical assistance may be required.

If the bleeding is small in amount, but recurs constantly, gastro-enterostomy should be undertaken, in order to put the organ at rest and allow the ulcer to heal. When, however, the hæmorrhage is more severe, a determined attempt must be made to find the bleeding spot and deal with it. The abdomen is opened and the stomach carefully explored. Some puckering or thickening of the coats may indicate the situation of the ulcer; failing this, a free opening in the longitudinal axis is made through the anterior wall, and the interior of the viscus methodically examined. When the bleeding point has been found, it may be possible to pick it up and tie it; or the whole ulcer may be picked up and ligatured *en masse;* or the base of the ulcer may be cauterized; or excision of the ulcer may be practicable. Failing these measures, gastro-enterostomy will be indicated, and the result is usually satisfactory.

2. **Perforation of the Ulcer** is by no means an uncommon occurrence in connection with the acute type of ulcer, and is therefore seen most frequently in young women; it is always fraught with the

greatest danger. The anterior wall is more
the posterior (7 to 1), owing to its greater mo
formation of protective adhesions. The ca
affected than the pyloric (5 to 3), whilst the
the lesser rather than the greater curvature
symptoms varies with the size of the perfo
tension or not of the viscus. If a large op
anterior wall, so that the gastric contents ar
into the peritoneal cavity, the patient is seiz
pain and profound shock, and this is follov
tonitis, which rapidly proves fatal if surgic
hand. When the perforation is small, and
occurs, the onset is subacute; the primary s
able, but epigastric pain and tenderness ar
marked rigidity of the abdominal wall; a sho
follows the primary shock, and then the sy
until the characteristic features of general p

The *Prognosis* of gastric perforation is e
unless active surgical interference is obtai
tively short time, hopeless peritonitis ensues.
95 per cent. of untreated patients die, whils
the worse the results.

Treatment.—Should it be decided for any
operate in a given case, the horizontal pos
the use of morphia to check peristalsis, ar
hold out any prospect of benefit. Operati
must be undertaken at as early a period a
often wise to delay for an hour or two to all
in measure from the initial shock. The m
to employ, since it is not possible to be cert
the lesion. The rules given above as to t
trating injury hold good in connection with
to the use of swabs for the removal of any
tents, and as to the value of peritoneal irrig
to excise the ulcer when found; all that is
aperture by means of Lembert's sutures, ap
string fashion, so as to bury the ulcerated su
may seem unwise to attempt closure of the
may be so situated as to render such closure
tube, free from lateral openings, is then intr
and gauze packed around it so as to less
toneal leakage. The patient is fed by the r
the fistula usually closes without much diffic

3. **Perigastric Inflammation** is a commor
may be either adhesive or suppurative in ch

Adhesive Perigastritis is in the first place p
sisting of a localized thickening of the s
marked in connection with chronic than
posterior gastric wall is often adherent acr

peritoneum to the serous membrane lying in front of the pancreas, and this fixity may be one of the factors which prevent the ulcer from healing, even as fixation to the periosteum over the tibia delays healing in an ulcer of the leg.

In a few cases adhesions form between the anterior wall of the stomach and the parietal peritoneum, and these may give rise to a localized fixed epigastric pain, usually increased considerably by distension of the organ. It may be treated safely by abdominal section, and division of the adhesion between ligatures. If left alone, not only may it cause inconvenience by the pain induced, but it may also determine internal strangulation or obstruction.

Suppurative Perigastritis may follow a small perforation with limited leakage, but is more usually due to an extension of the ulcer and an invasion of the perigastric tissues by organisms which escape from the stomach. The result of this is the formation of what has been already described as a subphrenic abscess (p. 979), which may or may not contain gas. It may burst anteriorly through the abdominal wall, or may perforate the diaphragm, giving rise to a basal empyema; and this in turn may burst into the lung or through the chest wall, so that fistulæ may appear in various places, through which the contents of the stomach may be discharged.

The abscess should be opened and drained in the way already indicated, but should a fistula form, it is almost hopeless to attempt to deal with it locally, and a gastro-enterostomy may then be required.

Stenosis is always liable to follow the cicatrization of ulcers of the stomach. In the small acute ulcer the contraction rarely leads to more than a puckering of the organ; but in the chronic ulcers of large size the organ may be much altered in shape, and definite stenosis may arise. If the contraction is in or near the cardiac orifice, symptoms akin to œsophageal stenosis may be produced, the patient returning his food shortly after swallowing it. If the pylorus is affected, the stomach is often much dilated, and vomiting of a special type ensues (see Simple Stenosis of the Pylorus, p. 995). It is important to note that muscular spasm plays a considerable part in the production of these symptoms when due to ulcer; the spasm is probably induced by the hyper-acidity of the gastric juice (hyperchlorhydria) which is often present.

The most exaggerated forms of gastric stenosis follow the cicatrization of a horse-shoe ulcer, and this constitutes the most common cause of an *hour-glass stomach*. Adhesive perigastritis and cancer are occasional causes. The constriction is usually situated about 4 inches from the pylorus, and may be so narrow as almost to divide the organ into two halves. Generally the great convexity is drawn up towards the lesser, and thereby two pouches are formed which sag downwards; in them food collects and undergoes decomposition. Vomiting more or less of a pyloric type ensues from the distension of the cardiac pouch, which is usually much the larger. On washing out the organ with a measured quantity of water, a

smaller quantity often returns, some being retained in the lesser sac. On palpation this latter may occasion a succussion splash, even when the organ is apparently empty. On again passing the tube after a short interval, offensive fluid may return, especially if the pyloric pouch has been palpated. Distension of the viscus (as by passing a stomach-tube and forcing air in with a bicycle pump) causes a definite bulging on the left side of the epigastrium in the first place; subsequently this may diminish, and the pyloric pouch become evident on the right side. Sometimes both pouches can be distinctly felt, or even seen, as well as the sulcus between them. No treatment is of any avail which does not provide for the drainage of both pouches and the efficient emptying of the whole organ. A few cases may be treated by excision of the stricture, or by its longitudinal

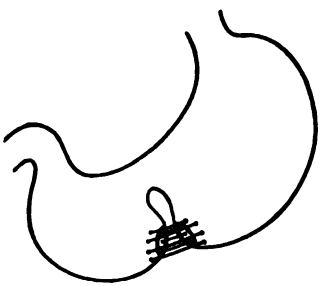

FIG. 360.—HOUR-GLASS STOMACH, INDICATING THE METHOD OF TREATMENT BY ANASTOMOSIS OF THE TWO POUCHES.

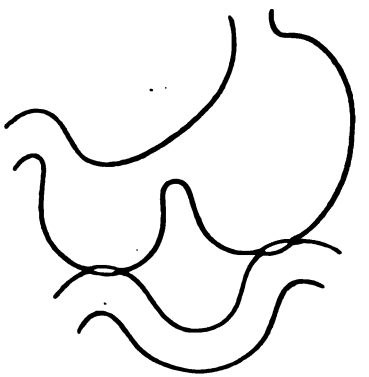

FIG. 361.—TREATMENT OF HOUR-GLASS STOMACH BY DOUBLE GASTRO-ENTEROSTOMY.

division and suture transversely by a method similar to that employed for the pylorus (see Pyloroplasty, p. 1001). In some cases the two pouches may be united below the stricture (Fig. 360), but there can be no question that the great majority are best dealt with by a double gastro-enterostomy (Fig. 361), which gives a direct communication between each segment and the jejunum.

5. Finally, cases are met with in which the symptoms of gastric ulcer persist or recur in spite of the most careful dieting and treatment, and it is now considered quite justifiable to submit such cases to operation. Two lines of treatment are possible. (*a*) The ulcer may be excised, if it be in a convenient position for such a procedure, and if the infiltration around it is not too extensive. This is, however, rarely practicable. (*b*) In most cases gastro-enterostomy (p. 1001) should be undertaken in order to relieve symptoms by enabling the viscus more readily to empty itself after the ingestion of food. The stomach is thereby put at rest, the ulcer is able to

heal, the patient's nutrition is quickly re-established, and the results are in every way gratifying.

Cancer of the Stomach.—The stomach is more frequently invaded by cancer than any other organ in the body in the male sex, whilst in females it comes next to the breast and uterus in order of frequency. Any and every part of the viscus may be affected, but in 60 per cent. of the cases the tumour starts in or about the pylorus, and is of a scirrhous nature. When the cardiac end is attacked, the disease may spread from the œsophagus and is a squamous epithelioma, but when the body of the organ is invaded, the condition is usually a columnar carcinoma.

Cancer occasionally starts at the site of an old ulcer, but there is generally no assignable cause for its onset, except an indefinite

FIG. 362.—CANCER OF PYLORIC END OF STOMACH. (KING'S COLLEGE HOSPITAL MUSEUM.)

The abrupt limitation of the growth at the commencement of the duodenum is well seen.

history of injury. It may occur as a nodular outgrowth, perhaps covered with papillomatous projections and early undergoing ulceration; if it is of a hard type, the ulcerated surface has a characteristic everted margin. Sometimes the whole organ becomes infiltrated by a diffuse carcinomatous growth, constituting a firm mass incapable of dilatation or much contraction, which has been aptly termed the 'leather-bottle stomach.' At the pyloric end (Fig. 362) the growth is always of a hard nature, and forms an annular constriction, through which it may be difficult to pass even a small catheter; it is sharply limited on its duodenal aspect, but spreads into the body of the organ, and especially towards the lesser curvature, following the main line of the lymphatic stream. The lymphatic glands lying along the lesser curvature are involved, usually extending as far as the point where the coronary artery reaches the stomach, whilst those

along the pyloric end of the great curvatur
degree (Fig. 368). Thence the affection sp
the cœliac glands, and there may compress t
thoracic duct. Adhesions form around the
under surface of the liver, to the head of the
even when of large size to the anterior abd
hesions often prepare the way for an extens
peritoneum, over which disseminated noc
scattered, often giving rise to a considerabl
The omentum also becomes infiltrated, an
not unusual in this region, the omentum be
translucent mass, looking sometimes like fi

Speaking generally, the malignancy c
decidedly less than that of such organs as
that secondary glandular affections are late
when the nearest group is involved it may
affection spreads to distant parts.

Clinical Phenomena. — Gastric cancer of
indefinite symptoms, the significance of w
in the early stages; the case is then often a
idea that it is merely one of 'dyspepsia,' 'i
like, so that a thorough and exhaustive e
and the time for radical interference passes
recognised. Pain is often the first symp
gradually increasing, and referred to the ep
may increase or relieve it, but as time prog
independently of meals. Acid eructations
oppression soon follow, and these in time gi
of vomiting, the ejecta perhaps containing
late in the case. Loss of appetite and stead
features in the early stages. The persist
symptoms should always lead to a comp
stomach and its functions. (i.) The epig
palpated and the nature and position of an
It may be desirable to inflate the organ wit
its exact size; by this means it is someti
tumour which would otherwise escape noti
of the gastric juice should be investigated
and the stomach tube. The meal consis
without milk and a small slice of toast
stomach, and for choice early in the mornin
and a quarter later. In cancer the an
diminished, whilst that of lactic acid is increa
a fermentation product. This test must b
but not as a constant, indication of the p
is usually increased, and not diminished,
venes on a chronic ulcer; and we have m
of ordinary cancer where the HCl was nor
Moreover, HCl is absent in many gastric

and hence this phenomenon must always be considered in conjunction with the other clinical symptoms. (iii.) The motor power of the viscus is very considerably lessened, so that the passage of its contents into the duodenum is delayed; this is due to a chronic interstitial gastritis. (iv.) A blood count in carcinoma usually reveals a well-marked secondary anæmia, together with a moderate leucocytosis. (v.) Microscopic examination of the vomit may also throw light on the case.

To these general signs certain special ones may be added, varying with the location of the growth. 1. If the *cardiac end* is involved, a tumour can rarely be detected, the stomach being small and contracted. The patient complains chiefly of pain on swallowing, and the vomiting occurs immediately after each meal. The symptoms are practically those of œsophageal cancer.

2. When the *pylorus* is affected, a tumour can often be felt a little above and to the right of the umbilicus, which is at first rounded and definitely limited, except on the left side, where it shelves off into the stomach; it is moveable in the early stages, but later on becomes fixed; it is firm in consistence, and somewhat tender on manipulation and pressure, and may receive pulsation from the underlying aorta. Owing to the stenosis of the pylorus, which almost invariably accompanies this condition, the stomach becomes dilated, and its great curvature displaced downwards, perhaps almost into the pelvis. In this a large accumulation of fluid takes place, which can be heard splashing about when the patient is moved; every day or two he brings up a large quantity of fluid and decomposing food, covered with a yeast-like scum, and sometimes containing sarcinæ in abundance. Hæmatemesis is not uncommon.

3. When the *body* of the organ is involved, a tumour may or may not be felt, according to its situation. The 'leather-bottle' stomach can be sometimes detected as a solid mass projecting forwards from under the left costal margin. The organ is not dilated, and the vomiting has no special characters; hæmatemesis may or may not be present.

In the later stages pressure phenomena manifest themselves. Ascites may result from compression of the portal vein; jaundice, from implication of the common bile-duct; œdema of the legs and varix of the superficial abdominal veins may arise from pressure upon the inferior vena cava, whilst the peritoneal cavity may be distended with chyle owing to the pressure of lymphatic glands on the receptaculum chyli or thoracic duct. All these later signs are indications that the time has passed when radical treatment is possible. A similar indication is given by enlargement of a gland in the left supra-clavicular fossa, which sometimes occurs; this results from dissemination of cancer cells up the thoracic duct.

Treatment.—So many cases of this affection reach the surgeon too late that, at the risk of wearying our readers, we would reiterate what has been already stated. When the symptoms of chronic gastritis persist in spite of careful dieting and treatment, and the

patient is losing flesh, one should alv
suspicion. Granted that the examinati
the characteristic changes referred to a
blood count indicates leucocytosis an
hæmoglobin, then an exploratory opera
the other hand, we would give a word of
practice of considering that the mere
epigastrium warrants an operation.
is present, the probability is that the
the reach of surgery, and therefore, un
tions for palliative treatment, *e.g.*, the
patient is often better left to the care
in many cases an operation is undertak
being able to do something to prevent
to certain death; but when ascites, ja
of dissemination are present, the surg
interfering.

For cancer of the cardiac orifice, gast
be desirable, the artificial stoma being
than usual.

For cancer of the body of the stoma
tomy (p. 1000) may be feasible in the a
but the conditions which permit of suc
there is any evidence of obstruction to
enterostomy (p. 1001) is undertaken, a
always useful in such a case in that it
itself more quickly. Owing to the usu
on the posterior wall, the surgeon may l
operation. Sometimes the disease is so
cedure is impracticable; the patient's
rapidly, and possibly life may be prolon
the formation of an artificial opening in
through which he may be fed without

For cancer of the pylorus, operation
whilst, even if removal is impracticable
circuit the growth may be feasible.
moveable, and there are but few adhesi
removal of the diseased portion of the
even should secondary deposits be pres
probably better off after such a proced
the growth is firmly adherent to adjace
is alone practicable, and will do muc
passage of food into the bowel witho
surface; it will also allow the dilat
pletely and quickly emptied, and
processes are minimized and the p
toxic absorption.

Failing all operative measures, the
maintained by such food as causes hi

considerable relief will be experienced from regular and systematic lavage of the organ. Opium will be needed for pain.

Simple Stenosis of the Pylorus results from a number of different conditions, and gives rise to a well-marked group of symptoms. (1) Most frequently it is due to the healing of a gastric ulcer, situated within or close to the pyloric orifice; in the acute form, where the ulcers are small, spasm as a result of the associated hyperchlorhydria is an important element in aggravating the symptoms caused by a slight contraction. (2) It may result from the contraction of extrinsic adhesions. These may be massive or bandlike; in the former case the pylorus is imbedded in the newly-formed fibrous tissue; in the latter it is kinked, and subsequently contracted. Such adhesions may be secondary to gastric ulcer, or may spread from an inflamed gall-bladder (peri-cholecystitis). (3) It is occasionally met with as a *congenital hypertrophy* of the pylorus, in which the overgrowth chiefly involves the muscular fibres. This manifests its presence in otherwise healthy children within a few weeks or months of birth by persistent vomiting immediately after food, unattended by pain or retching, and necessarily resulting in a steady loss of nutrition. The stomach becomes enlarged after a time, as in the other varieties, and the pylorus can sometimes be palpated as a moveable tumour.

The physical results of pyloric stenosis consist in hypertrophy and dilatation of the stomach, which becomes enlarged downwards, and forms a sac, in which food collects perhaps for days, and undergoes fermentative changes, being finally ejected in large quantities, mixed with frothy mucus and a yeast-like scum containing an abundance of sarcinæ. The stomach may in time almost reach the pelvis, the pylorus being dragged down with it. Succussion or splashing sounds are heard on shaking the patient's abdomen, and peristaltic waves may be elicited on tapping it sharply.

The **Treatment** consists at first in washing out the stomach regularly, but when that fails to give relief one of the following proceedings may be undertaken. (*a*) *Loreta's Operation* consists in dilating the stenosed orifice with the finger. The viscus is opened midway between the curvatures and about 2 inches from the pylorus, and first one finger is introduced, slowly and carefully, then two, and even perhaps three; no violence is admissible, or the walls of the orifice may be torn or ruptured. The results of this procedure are temporarily satisfactory, but it is now being replaced by more certain methods which are less likely to be followed by recurrence of symptoms. (*b*) *Excision of the Pylorus* has been undertaken in some cases, but is rarely available. The condition has usually gone on so long before operation is considered that the stomach is dilated and atonic, and even if the obstruction is removed food may collect and decompose in the pouch formed by the dilated organ. (*c*) *Pyloroplasty* (p. 1001) is useful in similar cases where the stricture is free from adhesions, and where it is narrow and annular, but will be useless in conditions similar to those under which pylorectomy is indicated. (*d*) *Gastro-enterostomy* is usually the operation of choice, inasmuch as it provides

more efficient drainage of the dilate
proceeding. The mortality is small, an

Acute Dilatation of the Stomach* is
ally met with in surgical practice, as an
sequela of injury or operation, and th
limited to the abdomen. It is rather m
arising either without apparent cause, o
illnesses. It is characterized by a sudde
mous quantities of fluid, and severe gen
terminate fatally in a few days. The s
dilated, even sagging down into the pel
less paralyzed, as peristalsis is rarely ev
condition is uncertain, but it is possib
third piece of the duodenum by the roo
downward drag of the intestines. **Treatm**
and in some cases the abdominal decul
alimentation is required. Surgical trea
good, unless there be some associated o

Operations upon the

1. **Washing out the Stomach** is needed i
catarrh, in dilatation of the organ, and
in which its cavity is to be laid open.
the ordinary stomach-pump, or by the
long tube of good-sized calibre, to the u
a funnel. Fluid is introduced through
by lowering it below the level of the s
tions, a warm solution of boric acid sho
for irrigating the viscus.

2. **Gastrotomy**, or opening the stomac
of foreign bodies from it or from the
for exploratory purposes, and as a mean
of either the pyloric or cardiac orifices

Operation.—An incision is made in
umbilicus unless there is some specia
The peritoneum is opened, and the sto
tion immediately under the liver, and b
and opacity of its walls. If the omentur
in the wound, it must be pushed down
above. The spot where the stomach is
and the part drawn out and carefully
gauze so as to prevent contamination of
The incision is made in the long axis of
inserted. The removal of a foreign bo
great care, so as not to inflict injury o
enlarged, if necessary. The stomach i

* For further details, see 'Acute Dilatation
Thomson, M.D. Baillière, Tindall and Cox, 1

Czerny-Lembert suture, and replaced; all traces of blood, etc., are removed, and the external wound is closed in the usual way.

The *cardiac orifice* is not easily reached, as it lies deeply just in front of the aortic opening in the diaphragm. It can be dilated by the fingers or by suitable dilators, and a foreign body by this means removed from the lower end of the œsophagus. The utmost gentleness must be observed in this proceeding, as serious symptoms may be caused by irritation or injury of the pneumogastric nerves, the terminations of which pass through this opening in the diaphragm.

The operations on the *pyloric orifice* are dealt with below.

3. **Gastrostomy** consists in the formation of a permanent artificial opening into the stomach, through which the patient can be fed. It is needed in cases of malignant disease or intractable stenosis of the œsophagus, where the patient is exposed to the risk of starvation, owing to his inability to take nourishment.

During the last few years a number of excellent operations have been introduced, whereby this end is secured without the resulting escape of gastric juice, followed by irritation and digestion of the surrounding skin, which were so constantly seen in the old days. Most of them depend on the formation of a muscular valve or sphincter, and there can be no doubt that the improvements thus effected have been very great. Two chief methods have been suggested —viz., Witzel's and Frank's; the latter of these is, to our minds, the preferable, and the results gained thereby are so satisfactory as to warrant us in describing it in detail.

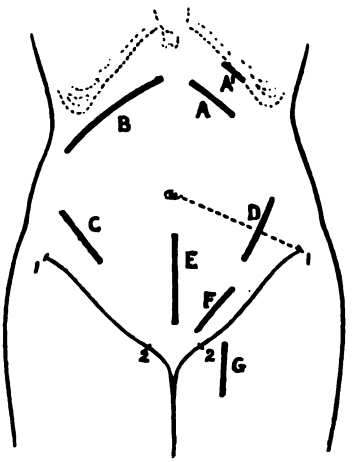

FIG. 363.—INCISIONS UTILIZED IN VARIOUS ABDOMINAL OPERATIONS.

A, Fenger's incision for exposing the stomach; A¹, additional incision in Frank's gastrostomy; B, incision for exposing the gall-bladder; C, incision for operations on appendix; D, left iliac colotomy; E, median incision for ovariotomy or supra-pubic cystotomy; F, for radical cure of inguinal hernia or varicocele; G, for femoral hernia; 1, anterior superior iliac spine; 2, pubic spine.

Frank's Operation.—Fenger's oblique incision (Fig. 363, A) for exposure of the stomach is first made, the viscus withdrawn and examined, and a silk sling passed through the serous and muscular coats at the site selected for the artificial opening, so that a cone-shaped portion of the wall can be drawn up into the wound. The parietal peritoneum is then sutured all round to the base of the cone, so as to shut it off from the general serous cavity. A second incision (A¹), about 1 inch in length, is now made on the outer side of

the apex of the cone, and through this is passed a piece of rubber drainage-tube, free from lateral openings, and about the size of a No. 10 catheter, exactly fitting the opening in the stomach; it should project 1½ inches inside the cavity, and about 6 inches of it should remain outside (Fig. 365). This is stitched firmly to the stomach wall, and the apex of the cone is then drawn to the upper angle of the incision. The halves of the rectus muscle are freed from the posterior layer of the sheath and drawn together by sutures, so as to cover in all the exposed gastric wall except the apex of the cone,

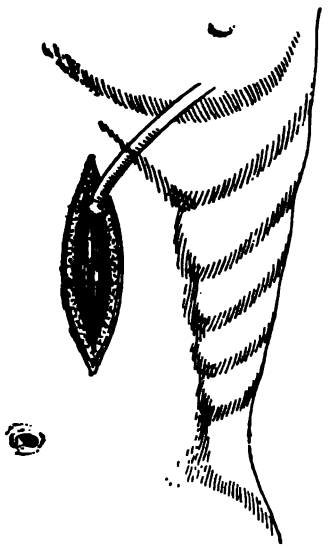

FIG. 366.

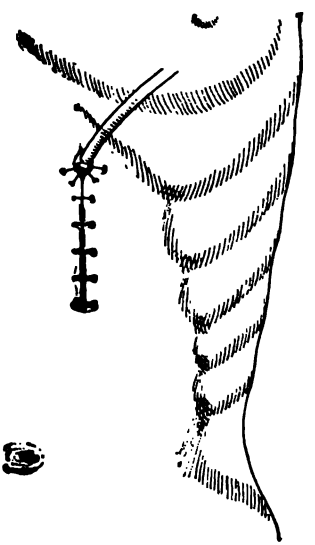

FIG. 367.

FIGS. 366 AND 367.—GASTROSTOMY (FRANK'S OPERATION MODIFIED).

In Fig. 366 the sutures in the rectus have been tied, and only a small portion of the stomach projects; in Fig. 367 the operation is completed.

which with the tube forms a nipple-like projection, around which the muscle fits like a sphincter (Fig. 366). The incision in the skin is then closed, and finally the serous and muscular coats of the projecting portion are carefully stitched to the skin. The results of this procedure have been most satisfactory, many cases having run their course without a drop of gastric juice escaping. The amount of food at first administered is small, and rectal feeding may be required in addition; but it is gradually increased until perhaps 17 ounces can be retained four times a day. The patient should be kept in the recumbent posture for three weeks.*

* For further details, see *Carless*, 'On Gastrostomy,' King's College Hospital Reports, vol. v., 1897-1898, and in *Edinburgh Medical Journal*, July, 1902.

and on the other so as to remove the greater portion of the lesser curvature, thereby including the lymphatic glands. Bleeding points are secured, and the two incisions completely closed, no attempt being made to appose or unite them. The first part of the jejunum is then drawn up, and an ordinary posterior gastro-enterostomy performed.

The chief danger of the operation is shock, but if this can be avoided by careful protection of the viscera, by the prevention of hæmorrhage, and by rapidity of execution, a good result may be expected. The patient is fed *per rectum* for the first forty-eight hours, if possible, but after that interval small quantities of fluid may be allowed, and the dietary gradually increased.

Pylorectomy *for simple stenosis* is quite a different matter; the pylorus alone needs to be removed, and there should be no difficulty in performing an end-to-end anastomosis similar to that recommended for intestinal lesions (*q.v.*).

6. **Pyloroplasty** consists in incising the pylorus and reclosing the incision in such a way as to increase the calibre of the tube. It is

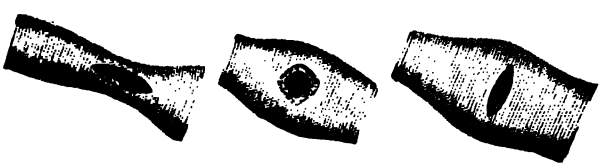

FIG. 369.—PYLOROPLASTY

The contracted bowel is divided longitudinally, and the aperture thus made opened out, so that it can be brought together transversely.

performed for various types of stricture. The operation commences by exposing the pylorus and clearing it from adhesions. A longitudinal incision is then made through the stricture, and by a little careful manipulation this wound can be opened out and brought together in a transverse manner so as to greatly increase the lumen of the orifice (Fig. 369). Two rows of stitches are inserted, one through the mucous membrane, and the other through the muscular and serous coats.

7. **Gastro-enterostomy**, or, more correctly, gastro-jejunostomy, is constantly resorted to in the treatment of gastric, pyloric, or duodenal lesions. Not long ago the mortality associated with this operation was so serious that it was looked on as a formidable undertaking; in careful and skilful hands the death-rate is now so small (well under 10 per cent.) that it is frequently employed. *Indications.*—1. For obstruction to the onward course of the food, whether in the stomach, pylorus, or duodenum, and whether simple or malignant in origin. 2. For stasis of the gastric contents (*i.e.*, retention in the stomach for an undue period—say, over eight hours), whether due to atony of the viscus or following on obstruction. 3. For persistent phenomena of ulceration, either of stomach or duodenum, in spite of suitable treatment. 4. For recurrent hæmorrhage under similar conditions, in order to put the parts at rest by rapidly emptying the stomach, or by

diverting the food from the duodenum. 5. As
operation of pylorectomy or gastrectomy.

The operation consists in the formation of a
tion between the stomach and intestine. It
selected portion of bowel should be the uppe
since, if the communication is established t
absorbing surface is isolated, with the result th
is successful, the patient gradually loses gr
nutriment; and the rapidity of the emaciati
communication is placed further from the duc

Operation.—The patient is generally prepar
stomach for a few days with some mild antise
done very cautiously, if at all, when ulcers ar
employed is usually one in the middle line
The stomach is readily found, and the cc
examined so as to confirm the necessity for th
it was
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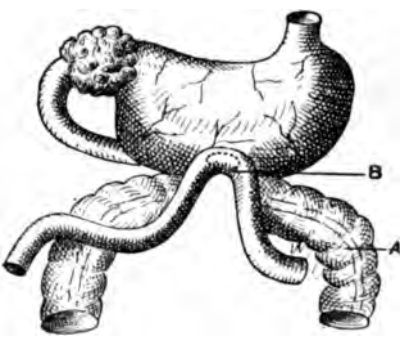


FIG. 370.—ANTERIOR GASTRO-ENTEROSTOMY.

A, Transverse colon; B, jejunum dragged up over the colon and omentum (purposely omitted) to be brought into apposition with the stomach.

efferent limb, thus establishing a vicious
vomiting results, which may prove fatal.

Hence the majority of surgeons nowadays
Von Hacker's *posterior* operation. The transv
from the wound, together with part of the ome
the transverse meso-colon to its attachment to
parietes, the termination of the duodenum is r
middle line along the lower border of the
superior mesenteric vessels lying in front of
upper portion of the jejunum is easily found,
making the anastomosis selected. It must
be, and placed so that the peristaltic wave

stomach to intestine, and not be reversed at the site of union. A hole is then made through the transverse meso-colon (Fig. 371), so as to open into the lesser sac of the peritoneum, and enable the posterior wall of the stomach to be reached; the margins of this opening are stitched to the posterior gastric wall. A clamp is placed on either side of the selected portion of bowel, so as to prevent the escape of intestinal contents when the gut is opened; but, of course, it is impossible to do the same to the stomach; the latter viscus ought, therefore, to be thoroughly washed out with some dilute antiseptic, such as boric acid, before the operation commences. Moreover, it is pushed forwards from behind by the assistant's hand

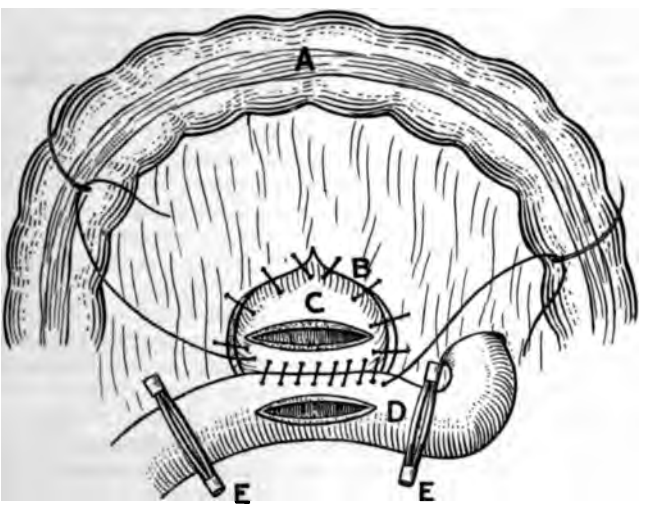


FIG. 371.—POSTERIOR GASTRO-ENTEROSTOMY.

A. Transverse colon thrown upwards, exposing the transverse meso-colon, through an opening in which (B) the posterior wall of the stomach (C) is exposed; the margins of the opening are sutured to the gastric wall. D, the upper end of the jejunum, with clamps (E, E) in position above and below the opening which is to be sutured to the opening in the stomach. The first sero-muscular stitch has secured the bowel and stomach in apposition.

in such a way that the opening is placed above the level of the rest of the viscus in the recumbent position of the patient, and there is therefore but little likelihood of leakage. Sterilized gauze strips are also packed around the site of operation, so as to receive any fluid which may escape.

The actual method of anastomosis usually employed at the present day consists in simple suturing the parts together without the aid of any mechanical contrivance. To this end two sutures only need be employed, one to unite the mucous membranes, the other for the sero-muscular coats. They may consist of silk or firm catgut,

making the opening in the jejunum as near the duodeno-jejunal junction as possible; the formation of a kink is thereby hindered. 2. A second opening is sometimes established between the afferent and efferent coils. 3. The jejunum is cut across, and a Y-anastomosis made (Roux), the lower segment being implanted at right angles into the stomach wall, and the upper or duodenal end into a second opening in the gut lower down. We doubt whether the two latter suggestions are justifiable; they can always be resorted to should the vicious circle of biliary regurgitation develop.

Ulcers of the Duodenum are very similar in nature and origin to those of the stomach. They occur most frequently in men thirty to forty years of age, and often without any obvious cause. Oral sepsis is not uncommonly present, as also hyperchlorhydria; in some cases chronic nephritis has existed, and in others the lesion follows some operation. The ulceration which forms a very occasional sequela of burns has been already alluded to (p. 113). The upper part of the duodenum is that usually affected, well above the entrance of the bile-duct; the character of the ulcer is similar to that seen in the stomach.

The **Symptoms** are often very uncertain if no complications are present. Pain may be noticed in the right hypochondrium, sometimes, but by no means invariably, referred to the back. When characteristic, it appears some little time after the ingestion of food, viz., two to four hours; vomiting is not a very frequent symptom, but when present it may relieve the pain. The ejecta may contain a certain proportion of bile. Hæmorrhage is another important sign, the blood being mixed with the vomit, or passing down the bowel and escaping with the motions (melæna). In a considerable percentage of cases, however, the condition is absolutely latent and free from symptoms until acute manifestations of perforation or hæmorrhage supervene.

Perforation usually involves the first part of the duodenum, and may be intra- or retro-peritoneal. The conditions produced are practically identical with those following a perforated gastric ulcer, but with slight differences due to the change of situation. Thus, with the usual acute intra-peritoneal perforation the fluid on escaping from the duodenum is guided downwards by the ascending meso-colon to the right iliac fossa, and hence the symptoms of acute appendicitis are somewhat simulated; but it may be possible to locate the primary pain to the hypochondrium. The mischief soon spreads, however, to the general cavity, and the localizing symptoms disappear. The effusion includes the fluid duodenal contents, often very abundant and perhaps bile-stained, and usually free gas. If the opening in the duodenum is small and the contents escape slowly, a subphrenic or subhepatic abscess may form, but the adhesions are not very firm, and it may burst secondarily into the general serous cavity. A retro-peritoneal perforation of the duodenum is the origin of a subacute subphrenic abscess, which is placed behind the peritoneal cavity, but always to the right side of the falciform ligament.

matory process. If adhesions have had time to form between the parietes and the injured gut, the mischief is limited, and the patient may recover with an artificial anus or fæcal fistula, the formation of which has been preceded by a localized intra-peritoneal abscess, containing extremely offensive pus, owing to the presence of the *B. coli*, which has migrated through the intestinal wall. If, however, the inflammatory affection is rapid in its onset, and adhesions have not had time to develop, acute diffuse peritonitis is almost certain to follow. When the injured portion of the bowel is retro-peritoneal, as in the duodenum or colon, a retro-peritoneal abscess may form.

The **Symptoms** of intestinal contusion consist primarily of shock and pain. The amount of shock varies necessarily with the severity of the injury and the nervous susceptibility of the patient. The pain may not be severe during the period of shock, but is always very marked subsequently, and increased by examination, movement, or during violent respiratory efforts. To limit such movement, the abdominal parietes are maintained in a state of firm contraction, and can be felt hard and resistant. Vomiting may be present, but is not a marked feature. The later symptoms necessarily vary with the course taken by the case, and need not be described in further detail.

Treatment is conducted along the same lines as that of contusions of the abdominal wall (p. 970), viz., where there is no absolute evidence of rupture, an expectant attitude must be adopted, but the surgeon must be ready to interfere should any grave or suspicious symptoms arise. Acute enteritis induces diarrhœa and the passage of blood-stained mucus, and such symptoms will indicate the use of bismuth, and perhaps a little morphia, whilst a fluid diet or rectal feeding is alone permissible.

Rupture of the Intestine follows abdominal injuries of a more severe character than those causing contusion, such as when a cart or cab has traversed the abdomen, or when the patient has been tightly squeezed. A distended coil is much more likely to give way than one that is empty: in the latter case it is quite possible for a small wound to occur, through which the intestinal contents are unable to escape, owing to the opening becoming blocked by eversion of the mucous membrane, or being covered over externally by omentum which becomes adherent. The bowel does not always give way at the point of impact, but occasionally at a distance from it: under these circumstances the tear is more likely to be ragged and irregular, whilst if it yields at the point struck, the gut may be cleanly torn across. The parts most frequently affected by this form of injury are the junction of the moveable jejunum with the fixed duodenum, and the lower 3 feet of the ileum. The fluidity of the contents of the small intestine has a grave prognostic significance, since they become diffused so readily. The effect of the accident on the mesentery is also of importance, since in the first place it may give rise to considerable intra-peritoneal hæmorrhage, and later on may cause sloughing of the gut as a result of thrombosis.

The early **Symptoms** consist of severe and usually lasting shock,

parallel to the axis of the bowel) is more likely to gape than a transverse one, owing to the greater power of the circular muscle fibres; a small puncture may be almost closed by a protrusion of mucous membrane. Shock is not necessarily so severe as when the intestine is ruptured by violence without penetration; abdominal pain is always present, and the phenomena of acute peritonitis quickly follow.

Treatment.—Every case of suspected penetration should be carefully explored. The skin and superficial parts of the wound are first thoroughly purified, and then the wound is laid open and the deeper parts examined. If the peritoneum is not opened, the different layers of the wall are sutured together. If the peritoneum has been involved, the opening in it should be enlarged, so as to explore the viscera and determine with certainty whether or not the gut has been wounded. If a small punctured or incised wound of the intestine is present, it is closed by a purse-string stitch or by a row of Czerny-Lembert sutures. If a more extensive lesion exists, excision of the damaged portion may be necessary; but if the patient is deeply collapsed from the supervention of peritonitis, it may be wiser to bring the divided ends to the abdominal wall, and form a temporary artificial anus, which is subsequently dealt with when the patient's general condition has improved. As to the treatment of the resulting peritonitis, we must refer to what has been written concerning rupture of the stomach (p. 988).

For **Gunshot Wounds** and their treatment, see pp. 240 and 241.

Perforation of the Intestine arises from many different causes, such as the impaction of a foreign body, or the yielding of an intestinal ulcer, as occurs in tuberculous disease or typhoid fever, or from that form of enteritis which follows strangulated hernia. We have already discussed the phenomena resulting from the perforation of an ulcer of the stomach or duodenum (pp. 987 and 1005), and another variety caused by perforation of the appendix will be alluded to subsequently (p. 1039).

When the jejunum or upper portion of the ileum is involved, perforation is usually due to the impaction of a foreign body, such as a fish-bone, or to yielding of a tuberculous ulcer. In acute cases, general peritonitis is almost certain to follow, and what we have written as to the results and treatment of such a lesion in the stomach applies here with equal force. Occasionally the lesion is of a more chronic type, especially when due to tubercle, and then adhesions first form, allowing an intra-peritoneal abscess to develop, and should this open externally, a fæcal fistula follows. In not a few cases the process of cicatrization may lead to a spontaneous closure of the fistula, and no operation should be undertaken until sufficient time has elapsed to determine whether or not this will occur. A similar condition sometimes results from tuberculous peritonitis, the umbilicus being a common site for such a fistula to develop. In other cases several coils of intestine may be matted together by adhesions, between which an abscess forms, and this, by opening into the bowel in two or more places, gives rise to a fistulous communication, known as *anus bimucosa*.

subjects of this condition, and there may be only a history of some inflammatory condition in the region of the gall-bladder, and none of biliary colic.

2. ***Enteroliths*** are of three classes: (*a*) Calculi of phosphate of lime or inspissated fæces form around some foreign body as a nucleus. (*b*) Masses of indigestible vegetable material may be matted together with inspissated fæces, mucus, etc.; they are said to be not uncommon in Scotland (the so-called *avenolith*), consisting largely of the husks of coarse oatmeal. They have also been known to consist of hair, or of cocoanut fibre in a patient engaged in mat-making. (*c*) Calculi have been found consisting of insoluble mineral salts, *e.g.*, carbonate of magnesia or chalk, taken as medicine. Whatever their origin, such enteroliths are likely to become impacted near the cæcum, and may cause acute obstruction. In thin persons their presence may be detected by palpation of the abdomen.

3. ***Foreign Bodies accidentally or intentionally swallowed*** occasionally pass through the stomach and become lodged in the intestinal canal. Lunatics and children are most frequently affected, and in the former the most astonishing collections are occasionally found. Thus Professor Agnew reports that he saw, in the dissecting-room of the Philadelphia School of Anatomy, a female subject, afterwards learned to have been insane, in whose intestinal canal were found three reels of cotton partially unwound; two roller bandages, one of them 2½ inches wide and 1 inch thick: the other was partially unrolled, one end being in the ileum, the other in the rectum; a number of skeins of thread, a quantity being packed tightly in the cæcum; and finally a pair of braces.

The **Symptoms** caused by such conditions will be either those of intestinal obstruction (p. 1107) or of perforation. In the latter the process is usually gradual, rather than sudden, giving time for adhesions to form, thereby limiting the mischief. Suppuration follows, and possibly the foreign body may be extruded by Nature or removed by the surgeon through the abscess cavity, with or without the formation of a fæcal fistula.

Small spiculated foreign bodies, *e.g.*, fragments of glass or metal, the husks of cereals, etc., may sometimes lodge in the pouches of the colon, and give rise to localized inflammatory phenomena, perhaps in one or more of the appendices epiploicæ. The symptoms will very closely resemble those of a localized appendix abscess, and similar operative treatment will be required.

Enteritis, or inflammation of the mucous membrane of the intestine, is a condition usually treated by the physician; occasionally it complicates surgical cases and needs effective treatment. Thus it may follow the exposure of a coil of intestine in the depths of a wound which has to be packed for drainage purposes. Severe diarrhœa may result, and the inflammation may even spread through the whole thickness of the gut wall, and lead to the establishment of a fæcal fistula. Enteritis also occurs as a post-operative complication of strangulated hernia (p. 1098). Whatever its origin, it is always

1. **Tuberculous Ulcers** are generally multiple, though occasionally single. They are of the usual tuberculous type, with undermined margins, and extend in the course of the vessels and lymphatics, viz., around the gut transversely, so that if they heal stricture is almost certain to follow. In their early stages they do not require surgical assistance, but later on obstructive phenomena may supervene, and these may be due not only to the stenosis, but also to associated peritonitis; neighbouring mesenteric glands are usually infected, and together with the bowel and omentum may form a palpable mass. Operation may be needed for the relief of the obstructive phenomena, and some form of anastomosis, or even excision of the mass, may be undertaken if it be practicable.

2. The disease is sometimes chiefly limited to the cæcum, producing a well-marked tumour, which can be palpated from outside, and is sometimes known as the **Tuberculous Cæcal Tumour**; the disease may, however, also extend into the ileum and along the ascending colon for some distance. The intestinal wall is thick, congested, and infiltrated with a tuberculous deposit; the outer coat is rough and nodulated; and the mass is firm, but not hard to the touch. The neighbouring mesentery is occupied by enlarged glands, and these may also be found on the inner border of the ascending colon. Adhesions may be present, and lead to kinking or twisting of loops of bowel, which may assist in producing intestinal obstruction. The symptoms vary a good deal, but in the early stages constipation and diarrhœa may alternate, whilst later on obstructive phenomena may supervene, or even well-marked pyrexia of a hectic type. The diagnosis from a cæcal carcinoma is not always easy; the chief points in favour of tubercle are the earlier age (under forty years), the longer duration of symptoms (two or three years), the associated pyrexia, and the presence of tuberculous lesions elsewhere. The diagnosis is, however, not uncommonly made on the operating-table. *Treatment* consists in entero-anastomosis, or excision of the mass. The latter may involve an extensive procedure, but even when enlarged glands have to be left behind, the case may do well. Thus, one of us removed the cæcum, ascending colon, and a foot or more of the ileum for this condition, implanting the ileum into the side of the transverse colon, which latter viscus was not above suspicion. Many enlarged glands had to be left; but the patient made an uninterrupted recovery, and has remained well; the pyrexia, which was very marked, disappeared on the day of the operation, and never returned.

Stenosis of the Intestine arises from two main causes—the contraction of cicatrices or adhesions, and the development of tumours, usually malignant.

Simple or cicatricial stricture usually results (1) from the healing of ulcers which have extended more or less circularly around the bowel, or have involved its walls extensively. Hence, tuberculous ulcers lend themselves to its development more than the typhoid lesion, and it is a little doubtful whether it has ever occurred as a sequela of the latter. Syphilitic ulceration is followed by it, especi-

intestinal contents, too, are fluid and very acid at this level, and give rise to much irritation of the skin.

Tumours of the Intestinal Wall may be simple or malignant, primary or secondary. *Simple* tumours are unusual, and consist of papilloma, adenoma, myoma, lipoma, and a few other varieties. They may cause irritation and irregular action of the gut, resulting, perchance, in intussusception (p. 1112); hæmorrhage, sometimes of a serious character, is associated with multiple papilloma or adenoma; and obstruction occasionally ensues. It is unusual for a diagnosis to be made apart from an exploratory laparotomy, unless the rectum is affected. The treatment is governed by the location of the growth and by the symptoms it causes.

Sarcoma of the intestine is not common; it may involve the ileum or cæcum, and gives rise to a localized tumour or diffuse infiltration. Obstruction may ensue, or considerable peritoneal irritation resulting in an abundant blood-stained exudation which leads to abdominal distension, and may be recognised as due to a new growth on tapping. Treatment consists in removal of the affected coil of gut if the disease has not progressed too far.

FIG. 372.—CARCINOMA OF THE DESCENDING COLON.

The growth was of the sclerosing type, and had given rise to no symptoms except a little diarrhœa until the onset of a fatal attack of obstruction.

Cancer of the Bowel is almost always primary in nature, and is then usually a columnar carcinoma, to which colloid degeneration is sometimes added. The small intestine is rarely involved, but any part of the colon may be affected. Secondary growths are occasionally met with, and are necessarily of the same nature as the original tumour. The physical characters of the growth vary considerably, but usually conform to one of two types—viz., (i.) the *hypertrophic*, in which a large mass forms, perhaps occupying the whole lumen of the bowel, but not necessarily. It is a fairly rapid growth, and usually associated with ulceration and hæmorrhage, whilst obstructive phenomena are late in appearing. (ii.) In the *sclerosing* form the tumour develops as an annular growth around the bowel, the lumen of which is contracted so that it may be almost impossible to pass a crow's quill or a probe through it (Fig. 372). It is an astonishing feature of these cases that the function of the bowel is carried on

without much pain or difficulty until the lume
and then suddenly a serious attack of obst
times the bowel looks from outside as if a p
tied round it, so great is the constriction.
bowel is hypertrophied and dilated; the muc
congested, inflamed, and even ulcerated; th
due to the irritation of stagnant fæces, and
'stercoral.' Bacteria may find their way
intestinal wall from these foci, and lead to per
and as a sequela a fæcal fistula may develop.
growth is usually distended ('ballooned') fro
and the development of gases from the fæc
accumulate from a loss of the *vis-a-tergo*; this
in cancer of the rectum.

The irritation of the growth leads sooner c
of adhesions, which may aid in hampering t
Secondary deposits occur in the mesenteric
and less commonly in the liver or distant re
no question that the growth is often much
than cancer elsewhere.

The **Symptoms** are at first vague in the e
is likely to have progressed for some time
reached. The patient complains of indigesti
there may be some pain of a colicky charac
tion or diarrhœa may be present; not unfr
the constipation being primary, and the diar
decomposition of retained fæces, or a ca
thereby. A discharge of mucus or blood
stools, and the patient's nutrition begins to
is at first slow.

The conditions which may require and ju
surgeon are as follows: (1) Repeated attack
especially if localized resistance of the ab
definite sense of fulness in some region is as
an acute attack of obstruction, the nature a
vary with the site of the lesion; (3) the
which, though at first readily moveable, soo
to the formation of adhesions to surroundi
development of a peri-intestinal abscess. O
evident that secondary growths are present
where, and the primary growth is so large or
doubtful, it is useless to undertake merely a
In these cases it will suffice to interfere when
make their appearance. The mere handling of
surface of which is probably ulcerated, is ofte
increased activity of the bacteria, and the de
around the growth, which may be followed
peritonitis, and even by the development of a
anus.

Treatment.—Except under the circumstances just mentioned, whenever a diagnosis of malignant disease of the bowel has been made or is suspected, an exploratory laparotomy is justifiable in order to confirm or disprove the fact. Unfortunately, cases are usually left until the progress of the disease has settled the question, and then palliative treatment may alone be possible. If found early enough, the growth, together with a good margin of healthy tissue on either side, should be removed, and the intestinal canal restored by enterorrhaphy. Affected mesenteric glands are included in the part excised if possible, but the total removal of the growth is quite justifiable, even if glands have to be left, inasmuch as it restores the functional activity of the tube. It must be remembered, however, that unless the bowel has been well emptied previously it is often wiser to make a temporary artificial anus, and restore the continuity of the canal at a later date.

Should excision be impracticable owing to the extent or fixity of the growth, the following plans of treatment may be considered, and that which best suits the requirements of the particular case undertaken.

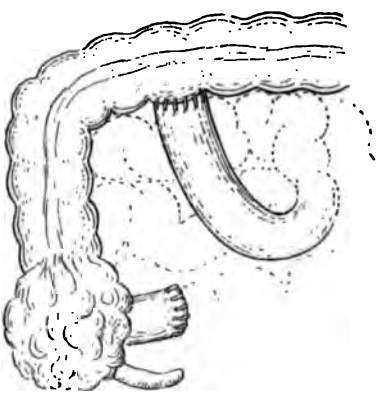


Fig. 373.—Lateral Implantation of Divided End of Ileum into the Transverse Colon for Irremovable Cancer of the Cæcum (Ileo-colostomy).

1. The growth may be *short-circuited* by uniting portions of gut above and below it. This is usually accomplished by one of the forms of lateral anastomosis described hereafter; thus, the cæcum may be attached to the sigmoid flexure in a case of cancer of the transverse colon.

2. The bowel may be entirely divided above the tumour, and the upper end implanted into the gut below it, the lower end of the divided bowel being sutured (Fig. 373). This *lateral implantation* is the best plan of treatment to employ for cancer of the cæcum which cannot be extirpated; the ileum is divided above the valve, and its open end implanted into the ascending or transverse colon well above the growth (ileo-colostomy), whilst the lower end is totally closed.

3. The affected coil of gut has been *excluded* from the intestinal tube by dividing the bowel above and below, and uniting the divided ends, whilst one end of the diseased coil is closed and the other is brought to the surface, and fixed there so as to establish a fistulous track. There is always a certain amount of discharge from the cancerous growth, and the mucous membrane itself secretes, so that total closure of the excluded loop would be accompanied by danger.

4. Finally, if none of these measures are applicable, or if the

patient's condition is such as to make it unwise if the growth is situated in the colon, an a established.

Idiopathic Dilatation of the Colon is a rare infancy, but occasionally lasting on till you characterized by enormous distension of the cc lower portion; possibly on opening the abdc colon is seen. The walls are hypertrophied, ar be present. The cause in many cases is unl contraction of the rectum has been found prominent symptom is constipation, and that stinate character, purgatives having no effect vomiting. Enemata are often retained, and ev passed; the introduction of a long flatus-tube is of very putrid gas in large quantities. Sooner tion follows, and may cause death. **Treatment** avoided, but massage and electricity may do be needed for obstruction, and possibly the pr case by Sir F. Treves may be justifiable, viz, sigmoid flexure, and descending colon, the t dragged down and fixed in the perineal openir

Enteroptosis, or Glenard's disease, is a conc met with in which there is a general displacen viscera. The small intestine, transverse colon, are the organs chiefly involved, but any of the The cause varies and cannot always be asce commences after an acute illness, more usu develops gradually. The relaxed abdomina repeated pregnancies is often present, and ti important causative factor. Women are n affected than men. The condition *per se* is not with symptoms, but in a considerable number o thenia is present. The amount of displacen the severity of the symptoms. The stomach costal arch, and when inflated stands out pro tures being visible; it is usually distended ato sounds may be heard. The relaxation of t alluded to in connection with the ætiology of l transverse colon may sag downwards almost i kinking at the splenic and hepatic flexures th an important element in the production of con and liver may also slip downwards. Displace referred to under the heading 'Moveable Kidn

Treatment must be wisely modified according due allowance made for the neurasthenic eleme Mitchell treatment (*i.e.*, rest and feeding) is of its influence on the nervous state and also in a deposit of fat. Electricity and massage to the to restore their tone and to improve the condi

viscera. An abdominal belt or bandage will do much to relieve symptoms, especially if applied with the patient in the Trendelenburg position. Operation is not to be lightly undertaken; but if a fair test has been given to the above measures, it may be justifiable to open the abdomen and stitch up into place organs like the stomach, liver, or spleen. For treatment of moveable kidney, see p. 1153.

Operations on the Intestines.

1. **Enterotomy** is a term which is only correctly applied to an incision made into the intestine either for the removal of a foreign body or for the examination of its interior. The wound should always be placed in the longitudinal axis of the gut, and along its anti-mesenteric border; it is closed by a row of Lembert, Czerny-Lembert, or Halsted stitches.

2. **Enterostomy**, or the formation of an artificial opening into the bowel, may be undertaken for several reasons, and any part of the gut may be opened. (*a*) The jejunum may be brought to the surface and opened (*jejunostomy*) in cases of cancer of the stomach where gastro-enterostomy and pylorectomy are impossible and the patient is dying of inanition; he can subsequently be fed by the fistula in this way produced. (*b*) The ileum may need to be opened and drained in cases of obstruction not lower than the cæcum or ascending colon, when the small gut is much distended and the patient's general condition so bad that no prolonged search for the cause and no attempt to deal directly with it, even if obvious, are possible. The abdomen is opened either in the middle line or in the right iliac region; a suitable distended coil is withdrawn and opened after carefully protecting the peritoneal cavity from fæcal infection. A large trocar and cannula are first introduced, so as to allow the first gush of flatus and fluid contents of the gut to escape; the opening is then enlarged and a Paul's (glass) tube tied in (Fig. 374), and the affected coil of bowel fixed to the abdominal wall. A thin tube of rubber is attached to the other end of the glass tube, and through this the intestinal contents are temporarily allowed to escape without contamination of the peritoneal cavity or of the wound.

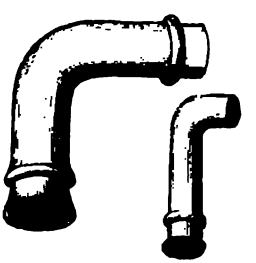


Fig. 374.—Paul's Tubes (Glass), Large and Small Sizes.

If the patient recovers from the acute symptoms, a second operation will be needed in order to re-establish the continuity of the intestinal canal. Life is not likely to be of long duration if an artificial opening exists above the cæcum, as the exclusion of the absorbing mucous surface of the large intestine seriously hampers nutrition.

(*c*) **Colostomy**, or, as it is more usually termed, 'colotomy,' is frequently employed in dealing with diseases of the lower bowel, and is an extremely successful proceeding.

lumbar operation, in which the upper part of the descending colon is reached behind or through the peritoneum, and the *iliac*, in which the upper part of the sigmoid flexure or lower end of the descending colon is brought to the surface after opening the peritoneal cavity.

Uses of Left Lumbar or Iliac Colostomy.—The operation is required under the following conditions: (1) For congenital absence of the rectum, when a perineal incision has failed to discover it; (2) for chronic obstruction of the lower end of the large intestine, which cannot be relieved by enemata or medical means, such as that arising from simple or malignant stricture, or from the pressure of pelvic tumours; (3) for carcinoma of the rectum or sigmoid flexure, whether obstruction is present or not, if a radical operation is impracticable, or as a preliminary to excision; (4) for some cases of syphilitic and

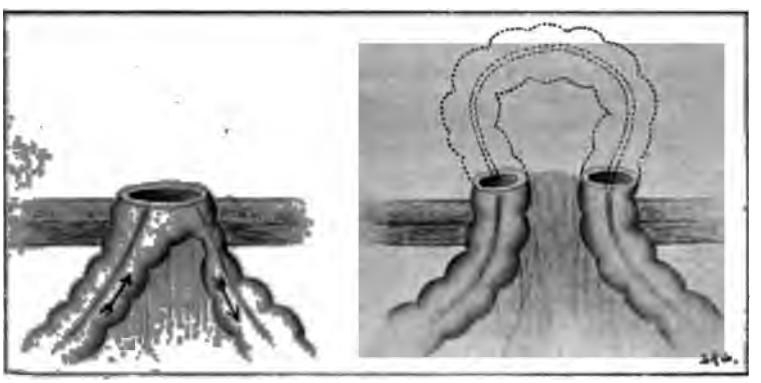


FIG. 375.—DIAGRAM OF TEMPORARY COLOSTOMY, SHOWING THE SINGLE OPENING ON A LEVEL WITH THE SKIN, THE PASSAGE TO THE LOWER BOWEL BEING MERELY BLOCKED BY A SPUR OF MUCOUS MEMBRANE.

FIG. 376.—DIAGRAM OF PERMANENT COLOSTOMY, SHOWING THE TWO OPENINGS SEPARATED ONE FROM THE OTHER BY A SECTION OF THE MESENTERY.

The dotted portion indicates the amount of bowel cut away; but, of course, such an extensive resection is only practicable when there is a very long mesentery, which is unusual.

other forms of ulceration of the rectum, which cannot heal as long as they are irritated by the passage of faeces; (5) for irremediable cases of recto-vesical and recto-vaginal fistula, whatever their origin; (6) for volvulus of the sigmoid flexure, the iliac operation being needed not only to relieve the obstruction, but also to prevent recurrence.

Left Lumbar Colostomy (Amussat's Operation) has been much neglected of recent years, and practically replaced by its iliac rival. Performed as it was in the old days without opening the peritoneal cavity, this operation was certainly not a desirable one; but if the method described below is adopted, it will probably be found as

portion of the colon or sigmoid flexure through the anterior abdominal wall. An incision 2 to 3 inches in length is made at right angles to a line extending from the anterior superior spine to the umbilicus, the centre of the incision corresponding to the junction of the outer and middle thirds (Fig. 363, D). The abdominal parietes are divided, and the peritoneum opened. Two fingers are then inserted, and the sigmoid flexure sought for; it is recognised by the presence of the appendices epiploicæ and the longitudinal bands of muscle fibres. It is carefully examined, and the upper part of it selected for fixation in the wound, so as to diminish the risk of subsequent prolapse. It is desirable to withdraw a coil about 4 or 6 inches in length, together with its mesentery. Many different plans of fixing it are in vogue, but the method we prefer is to pass a strong silk thread through the parietes and parietal peritoneum on either side of the wound, the stitch traversing the mesentery *en route*. It is then made to traverse

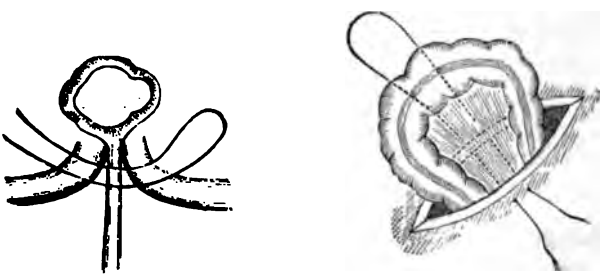


FIG. 377.—ILIAC COLOSTOMY TO SHOW FIXATION STITCH PASSING THROUGH MESENTERY AND ABDOMINAL PARIETES.

the same structures once more in exactly the same way, but at a distance of about ½ inch from the former (Fig. 377). The loose ends are then tied together, so as to bring the parietal peritoneum and sigmoid meso-colon into close apposition. A few additional stitches should be inserted, uniting the skin to the longitudinal muscular bands at each end of the incision, so as to prevent any subsequent retraction of the exposed bowel or escape of small intestine. Some surgeons simply secure the parietal peritoneum to the gut by a row of carefully inserted sutures; others pass a glass rod through the mesentery and stitch the peritoneum to the skin, whilst it has also been suggested to make a hole through the mesentery and suture the two edges of the incision through it, *i.e.*, beneath the bowel. The projecting portion of gut is then covered with purified protective, and an antiseptic dressing applied. At the end of two or three days the bowel is opened, no anæsthetic being generally necessary for this proceeding. About the eighth day a portion of the whole lumen of the gut should be removed, down to and even including the mesentery, so as to completely separate the upper from the lower end, and thus establish an efficient spur. The deep stitch is removed about the twelfth day. Should it be necessary to

open the bowel at the time of operation, t
withdrawn and the deep trans-mesenteric
The margins of the wound are then carefull
compresses, and the bowel is tapped wit
When the first gush of flatus and fæces has
enlarged and a large-sized Paul's tube tie
carefully sutured all round to the bowel and
like pad of gauze protects the junction.
free about the fourth day by sloughing of the
by the ligature, but the wound is by that tim
risk of intra-peritoneal infection exists. If
hand, a large drainage-tube without lateral
into the bowel in its stead.

When cicatrization of the wound is comple
is required in order to keep the patient clea
of a hollow oval cup, made of plated meta
with a rolled edge, and kept in position eit
an abdominal belt. This hollow cup sho
include a 2-inch margin of skin all round
concavity a small portion of antiseptic dres
apparatus enables the patient to go about
the bowels are encouraged to act thorou
means of an enema, so that no further distur
the day.

Comparison of the Two Operations.—W
did not include opening the peritoneal c
dangers were not inconsiderable, and one
reasons why it was discarded so completel
difficult to find, and a good deal of brui
subperitoneal fat resulted; occasionally sor
was opened by mistake, whilst it was d
draw the gut to the surface so as to
The wound became infected, and serious
follow.

At the present time the methodical and
peritoneal cavity obviates nearly all of t
advantages of the iliac operation are not n
formerly. (*a*) One great advantage is the
pelvic growth, which can be carefully exa
phatic glands in the meso-rectum or lumb
indications as to the advisability or not of
can be thereby obtained. (*b*) An artificial
region can be attended to by the patient hi
and is more easily cleansed and protecte
possible for a certain amount of sphincteric
after the abdominal operation, owing to the
parietes becoming adherent to the coats of t
can only be attained when these structures a
apposition, as by the fixation stitch describ

by uniting the margins of the abdominal wound through a hole in the meso-colon. The conditions are only favourable for this in a few instances.

It is sometimes desirable to close a colostomy wound after a shorter or longer interval. The plan usually adopted at the present day is to dissect up the margins of the wound, freeing the gut from its attachments to surrounding parts, and excising the affected segment; in this way the continuity of the canal can be restored without leaving parietal adhesions. Occasionally it may seem desirable to close the opening without encroaching on the peritoneal cavity. It is then necessary to efface or remove the spur, which would otherwise hinder the onward passage of the faeces. This may be effected by stitching a piece of drainage-tubing of large calibre into the bowel so as to reach above and below the opening; the margins can then be pared and closed in some suitable way; after a time the stitches in the drainage-tube (catgut by choice) will be absorbed, and it will pass on down the canal. In still other cases where the spur is more prominent, it may be necessary to destroy it by a suitable clamp (*e.g.*, Dupuytren's enterotome) before attempting to close the opening. It must not be overlooked, however, that this latter method of dealing with an artificial anus is extremely unsatisfactory, as it leaves an adherent coil of intestine, which is certain to hamper peristalsis and may cause recurrent colic, or may even determine an attack of obstruction; the open operation is usually very successful.

3. **Enteroplasty** is a plan of treatment which has been devised for dealing with cicatricial strictures of the intestine, and is based on the same idea as the operation of pyloroplasty for fibrous stenosis of the pylorus (p. 1001). A longitudinal incision is made through the stenosed gut along the anti-mesenteric border; this is opened out, and converted into a transverse cleft, which is carefully sutured, the lumen of the bowel being thereby considerably increased.

4. **Enterectomy**, or excision of a portion of the bowel, is required in the following conditions: (*a*) For the removal of gangrenous gut after strangulation, whether internal or external; (*b*) in the treatment of multiple penetrating wounds, as after a stab or gunshot injury; (*c*) in dealing with an artificial anus or faecal fistula; (*d*) for the removal of simple or malignant strictures; and (*e*) in some cases of intussusception. Not long ago the operation was but rarely undertaken, and the results were most unsatisfactory; but at the present time a very considerable degree of success may be expected, and enterectomy is frequently practised. Naturally, the results vary largely with the condition for which it is performed, with the site of the lesion, and with the experience and skill of the operator; a much higher rate of mortality follows when the excision is done for malignant disease, for gangrene following strangulation, or for intussusception, than when performed for other causes. Operations on the large intestine are also much less favourable than those directed to the small gut.

Whenever practicable, the bowel should be thoroughly emptied

can be obtained by passing a piece of drainage-tub
mesenteric attachment, and tying or clamping it arou
The affected portion is now removed by scissors, cu
the bowel and taking away a V-shaped portion of t
after securing as far back as possible the main nutri
the diseased area, according to Murphy's recommenda
be remembered that the terminal vessels run circula
gut, and have but little lateral anastomosis, and t
desirable that the incisions should slightly diverge fr
teric attachment, otherwise the projecting edge of the a
border is certain to slough, and septic peritonitis will
operators recommend that the mesentery should not b
that the gut should be detached from the mesenteric j
practice will suffice when merely a small segment
to be removed; but if a large portion needs resection,
a much longer time to secure all the bleeding-spots.
the mesentery is subsequently secured by sutures, an
ends of the bowel united by one of the many forms c
described below.

5. **Entero-anastomosis** is required for any condition in
a solution of continuity of the intestinal wall, and n
methods employed vary according to the character ar
the lesion. We have already alluded to the plans th
in dealing with longitudinal wounds of the gut. T
methods that remain to be discussed are the end-to
a totally divided segment of the bowel, and the m
lateral approximation or union is secured.

For **end-to-end union** the following are the chief pl
been adopted.

A. Entero-anastomosis by *simple suturing*. In this

coats are now united all round by one or two continuous stitches of the Lembert or Cushing type. Extreme care must be taken in dealing with the mesenteric attachment, as the peritoneal coats separate there in order to enclose the bowel, and the muscular coat retracts considerably; leakage is more likely to occur at this point than at any other.

Some surgeons advise that the first row of stitches should include the whole thickness of the gut, and that the second row should be of the Lembert type. With this we do not agree, as it involves too great an infolding of the gut wall, and thereby the lumen at the site of anastomosis is unduly encroached on, and some amount of stenosis may result.

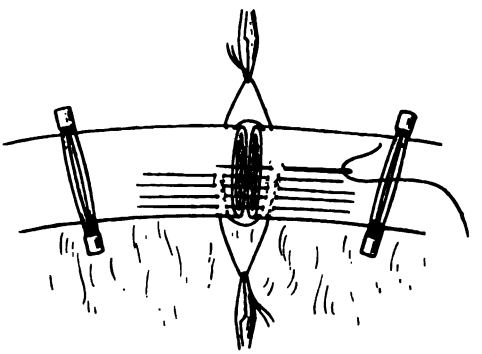


FIG. 378.—METHOD OF UNITING DIVIDED ENDS OF THE SMALL INTESTINE BY INTERRUPTED LEMBERT SUTURES.

For clearness' sake, the first row of stitches in the mucous membrane has been omitted.

In the *large intestine* this type of anastomosis is not always easy to accomplish, owing to the greater complexity of the peritoneal relations. It is often necessary to introduce the sero-muscular stitches first on the posterior aspects of the section, and subsequently those for the mucous membrane; but it is an open question whether a lateral anastomosis is not a better procedure in dealing with the colon. One thing is quite certain—viz., that unless the colon is satisfactorily empty, no anastomosis should be attempted until the bowel has been effectively drained, and hence a temporary colostomy is often necessary, and resection or anastomosis is performed as a secondary procedure.

B. A vast amount of ingenuity has been expended in the production of a variety of *bobbins* and *buttons*, with the idea of facilitating entero-anastomosis and making it safer. The methods of attaining this object vary, but according to the underlying principle one may divide them into two groups:

(1) Those which aim merely at providing an internal splint, which shall serve as a firm support to facilitate the introduction and tying of the stitches, and shall subsequently protect the line of union for a time. A hollow tube of turnip or potato will do quite well, but ***Robson's bobbin*** (Fig. 379), made of decalcified bone, is perhaps more convenient in that it can be kept ready for use in a variety of sizes. Mr. Robson recommends that two continuous sutures should be employed, one to unite the divided ends of the mucous membrane, and the other to approximate the serous and muscular coats

(Fig. 380). It will be found advanta
at each end of these. The sero-sero
the posterior half of the incision, eac
the sero-muscula
metre from the
suture is then pu
bobbin is now p
mucous suture i
finally the anter
suture is similarl
sutures must be
so that no slippin
which it is comp
as to do no sub
membrane, since
the course of a fe

FIG. 379.—MAYO ROBSON'S BOBBIN. (DOWN BROTHERS.)

(2) The majorit
mation and appo

Murphy's button (Fig. 381) may be
these contrivances. It is made of ste

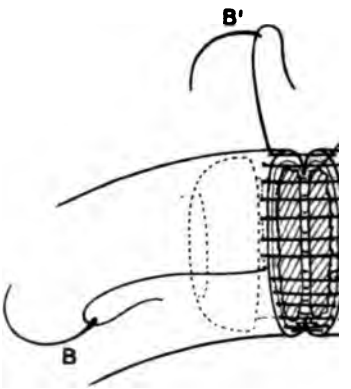


FIG. 380.—ENTERO-ANASTOMOSIS

A, A' is the internal suture for approximat
brane; B, B' is the external continuo
according to Cushing's method.

which can be easily approximated, b
screwing. In the male half there
flange (I'), separated from the former
two halves are approximated, the inne
against the female half (Fig. 384), an
tissues grasped between the two segm
the button free. In the meantime, h
of lymph will have occurred along t
to prevent extravasation and to secur

In performing end-to-end anastomosis, a running thread is inserted through each end of the divided intestine in the manner shown in Fig. 382. A half-button is introduced into each end of the divided gut, and preferably the heavier male end into the lower segment; the stitch is then drawn tight and tied, so as to gather up the gut wall round the central stem of the button (Fig. 383). The two halves are now approximated (Fig. 384), sufficient force being employed to bring the walls of the gut into accurate apposition, but without exercising injurious pressure.

Full Size

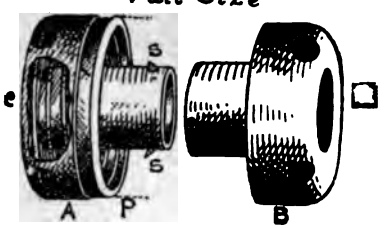


FIG. 381.—MURPHY'S BUTTON.

A, Male half; B, female half; P, inner cup or flange of male half, governed by *c*, spring; S, spring catches working along a screw thread on the inner aspect of the central stem of the female half.

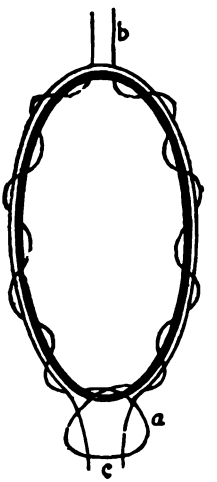


FIG. 382.—METHOD OF INSERTING SUTURE FOR END-TO-END ANASTOMOSIS WITH MURPHY'S BUTTON.

a, Overstitch to secure mesenteric attachment; *b*, antimesenteric border and two ends of suture; *c*, mesenteric attachment.

The button is generally set free about the seventh day, and should pass downwards, and be expelled any time from the fourteenth to the twenty-first day.

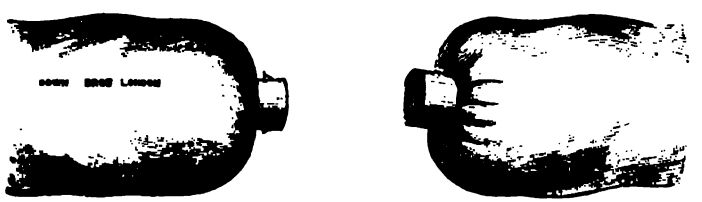


FIG. 383.—APPEARANCE OF INTESTINAL SEGMENTS WITH MURPHY'S BUTTON TIED IN. (DOWN BROTHERS.)

Whilst fully acknowledging the enormous educational value of this contrivance, in that Murphy thereby demonstrated to the profession the principles that underlay the operation of entero-anastomosis and showed that success ought to be possible in a large percentage of

the cases, yet the button itself has done it little used. The only advantage is the r anastomosis can be performed. Obviously large metal instrument of this type into the intestinal tube cannot be devoid of great dangers, and fatal issues have certainly occurred from sloughing, from want of union due to the use of too large a button, or of one badly constructed, and even from subsequent obstruction and perforation when it has passed lower down. On the whole, one would be inclined to use it for end-to-end anastomosis only when time is of value, and the patient's general condition such as necessi-

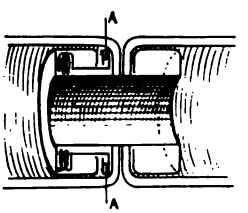


FIG. 384.—LONGITUDINAL SECTION OF INTESTINE WITH MURPHY'S BUTTON IN POSITION.

A, A indicates the inner cup united to the outer by springs which determine pressure-atrophy of the portion of gut wall grasped by the button.

FIG. 38
MOSIS
PLETE
The divi
suture
a ser
stitch
in the
and t
united
(B, B¹
muscu
round

tates the utmost speed in operating; under would always employ some other method.

Many imitations of Murphy's button, m etc., have been introduced, but they are of r

6. **Lateral Anastomosis** of the intestine i order to effect the short-circuiting of some a stricture which cannot otherwise be deal employed instead of end-to-end anastomosis of intestine. The open ends are first entire Czerny-Lembert stitches, and the portions o

The actual anastomosis is performed as for gastro-enterostomy (Fig. 385). The sero-muscular coats on the posterior aspect of the proposed junction are first united; then the incisions are made; a continuous stitch unites the mucous membrane all round, and finally the external sero-muscular stitch secures the anastomosis. If thought desirable, a Robson's bobbin may be introduced.

7. **Lateral Implantation** is a procedure not uncommonly required in order to short-circuit a malignant growth (Fig. 373). It is perhaps employed most frequently for irremoveable cancer of the cæcum; the ileum is divided well above the growth; the lower end is closed, and the upper united to the transverse colon. The junction may be made by simple suturing, two rows of stitches being introduced; or a Murphy button may be used, and in this procedure excellent results follow its employment. The female half is tied into the divided end of the ileum by a stitch as for end-to-end anastomosis. The male half is secured into a longitudinal incision in the colon by a simple purse-string suture, passing through the entire thickness of the gut wall. This operation of ileo-colostomy is the only one for which we consider Murphy's button generally applicable.

Appendicitis (*Syn.*: Perityphlitis, Epityphlitis, etc.).

Appendicitis is an affection which may appear at any time of life, but is most common in young adults. The male sex is more frequently attacked than the female, in the proportion of 3 to 1. The disease is sometimes of but slight significance, but occasionally runs such a virulent course as to destroy life in a few hours. Its importance lies in the fact that it is an infective process, and inasmuch as the peritoneal envelope is generally involved, a certain degree of peritonitis is almost necessarily a consequence.

Ætiology.—Many different conditions contribute either directly or indirectly in determining an attack of appendicitis. (1) The appendix is to be looked on, not as an actively functional structure, but as a degenerated relic or remnant, which is apparently of little value or importance. Hence, as in other similar structures, it often has but a poor blood-supply, derived from the posterior ileo-cæcal branch of the ileo-colic artery. The main nutrient vessels traverse the meso-appendix, but a second twig often runs down the base of the mesentery, and is more or less independent of the others. In the female it is said to have an additional supply from the right ovarian artery, and this may explain why the disease is less common in females than in males. Some authorities join issue with the above-mentioned view as to the inutility of the appendix, and maintain that it secretes a fluid which stimulates the peristalsis of the cæcum or colon. This may be so, but the fact remains that a vast number of people who have lost their appendix by operation get on quite as well without it. (2) A large amount of lymphoid tissue is present in the mucous membrane, so much, in fact, that the title of 'abdominal tonsil' has been applied to it. Inflammatory processes are thus readily set up within

to stenosis of its orifice, but it is rarely implicated in typhoid fever. Tubercle and actinomycosis may affect it concurrently with the cæcum. (8) *Injury* in the shape of a strain or sudden twist is not unfrequently mentioned as the cause of an outbreak, and probably acts by displacing a long appendix in such a way as to lead to its kinking and possibly to obstruction of the nutrient vessels. When a concretion is present it is easy to understand that the final attack is determined by some traumatism which will modify the vascular conditions around it. When an appendix is filled with muco-pus as a result of stenosis, either at the orifice or in the tube itself, a blow may lead to its rupture and cause an outbreak of acute diffuse fatal peritonitis.

There can be no question as to the greatly increased frequency of appendicitis at the present day, especially amongst those who live in large towns or cities. It is difficult to assign any one cause for this, but possibly many conditions may be at work, *e.g.*, (*a*) dental degeneration and consequent oral sepsis; (*b*) the bolting and non-mastication of meals associated with the hurry and scurry of modern life, leading to chronic irritation of stomach and bowel. (*c*) Chronic constipation is a most important factor. (*d*) The presence of minute foreign bodies in imported corn and other food-supplies may have some influence, whilst the chips derived from enamelled cooking utensils are by some considered of importance.

Pathological Anatomy.—Whatever the assigned cause may be, it must ever be kept in mind that appendicitis is an infective malady, due to invasion of the walls of the appendix by organisms, especially the *Streptococcus pyogenes*, the *B. coli*, and other anaërobic intestinal bacteria. These find an entrance into the wall of the appendix either through an eroded area of the mucous membrane due to the impaction of a foreign body or of a faecal concretion, or else they are absorbed into the lymphoid tissue so abundantly present, and at once commence to develop and multiply. The results may be best described under the following headings:

(1) **Changes in the Appendix Itself.**—These vary considerably in intensity and character according to the cause and the power of resistance of the individual.

In the *simple* or *catarrhal* type the appendix looks red and swollen, and its peritoneal surface may be smooth, or roughened by loss of endothelium and deposit of lymph. It feels stiff from effusion, and has lost its natural flexibility. The muscular coats are often infiltrated with leucocytes, and this is especially noticed around the hiatus muscularis through which the vessels enter. The mucous membrane is thickened, engorged, and infiltrated with polynuclear leucocytes. The epithelium may be thickened, and here and there erosion or ulceration is present. If the process goes no further, healing occurs after a time, and this is often associated with fibrosis, which may show itself (*a*) as a more or less generalized sclerosis of the whole appendix, which may remain stiff and hard, and is perhaps twisted on itself (Fig. 386); or (*b*) as a stricture of the tube, which

through which the concretion may escape (Fig. 387). In all these cases a grave peritoneal infection follows.

(2) The **Peritoneal Phenomena** associated with appendicitis are of the utmost importance.

In the milder cases the peritonitis is protective in type. The serous coat of the appendix becomes inflamed, sheds its endothelium, and becomes roughened by a deposit of lymph, and this results either in a thickening of the wall, or in a formation of *adhesions* which tie down the appendix in various directions and positions. Most commonly it is simply fixed to the cæcum along part of its length, but sometimes it is firmly united to it for its whole extent. Adhesions may pass between the appendix and the omentum, or the mesentery, or ovary, etc.; in fact, the appendix may be united to almost any of

FIG. 387.—PERFORATION OF THE APPENDIX FROM AN IMPACTED CONCRETION, CAUSING AN ACUTE ABSCESS (SEMI-DIAGRAMMATIC).

the viscera, and may thereby hamper their action or give rise to some form of acute obstruction. It may also contract adhesions to the fasciæ, *e.g.*, over the psoas sheath or iliac vessels, and various symptoms may be caused thereby.

In the graver cases an infective peritonitis occurs, and, according to the virulence of the organisms, the defensive powers of the patient, and the character of the infection, the process may be localized or not. A *localized intra-peritoneal abscess* is by no means uncommon; its extension is limited by the formation of adhesions between the omentum, the parietes, and neighbouring coils of intestine. Its exact anatomical relations depend on the original situation of the appendix. Frequently it is located below and behind the cæcum; sometimes it burrows down into the pelvis; in other cases it passes inwards amongst the intestines; it may track up towards the liver either on the inner or outer side of the ascending colon. The abscess may burst externally, and its approach to the surface will be heralded

it may develop subsequently as a result of kinking or strangulation by bands or adhesions.

Clinical History.—(i.) The mild variety of the disease, known as a simple **catarrhal appendicitis**, to which is added merely a localized plastic peritonitis, usually commences somewhat suddenly, the patient being seized with pain, which is at first referred to the umbilicus or to any part of the abdomen, but at the end of twenty-four to forty-eight hours localizes itself to the right iliac fossa. It is often of a sharp cutting character, but varies much in intensity and duration. Fever is usually present, and the attack may start with a rigor. The patient may complain of nausea and vomiting, but the latter symptom does not last long. Constipation results from the intestinal paralysis due to the inflammatory lesion, and in bad cases may be sufficiently severe and prolonged to constitute an attack of obstruction with fæcal vomiting. In children it is sometimes replaced by diarrhœa, and that even blood-stained, so that the diagnosis may need to be made from typhoid fever.

On examination the abdomen is found to be held more rigid than usual; the right leg is often drawn up to relax the muscles, and in bad cases all abdominal respiratory movements are abolished. Even in mild cases the muscles over the right iliac fossa are held tense and rigid so as to guard the underlying structures. Definite tenderness is noted on pressure, and the patient will often, but by no means constantly, refer it to a spot about 1½ inches from the anterior superior iliac spine along a line drawn to the umbilicus (McBurney's spot). In many cases, where the appendix is directed backwards, there is marked tenderness in the lumbar region; but if it points downwards into the pelvis, there may be pain and tenderness on rectal or vaginal examination, which should never be neglected. A definite swelling may sometimes be detected by palpation, usually above the outer half of Poupart's ligament, but varying in its position with the site of the appendix; it may be dull on percussion, but is frequently tympanitic, since it consists of coils of intestine and omentum matted together around the appendix. The absence of a definite lump is due to the non-development of protective adhesions, and hence is noted in the worst cases of perforative appendicitis; or it may be caused by the inflamed mass lying deep in the abdomen, and being covered over by distended and uninflamed intestine.

This simple form of the disease usually lasts three or four days, and then, if properly treated, resolves satisfactorily without abscess formation. It is exceedingly common, and the prognosis is, on the whole, favourable. Tofft, of Copenhagen, found adhesions in the neighbourhood of the appendix in 35 per cent. of all bodies subjected to post-mortem examination.

(ii.) The more serious variety, commonly resulting in a **localized abscess**, may commence in a similar way, but with more acute symptoms. There may be an initial rigor, and the temperature soon runs up, even to 104° F. Some general abdominal tenderness and distension follow; constipation is often absolute, and fæcal vomiting may

occur. The muscles on the right side of the abdominal walls are held tense and rigid, and a well-marked fulness can sometimes be detected in the iliac fossa. In other cases a distinct swelling can be seen as well as felt, and is not necessarily limited to the right fossa, but may appear in the middle line of the abdomen or elsewhere. Under a careful régime this may disappear, and the symptoms gradually abate in their severity, the temperature and the pulse falling concurrently; but it is very common for suppuration to ensue, and such is indicated by the temperature persisting at its original high level, or by the pulse-rate increasing in rapidity, whilst the temperature falls. Fluctuation is rarely to be detected in the early stages, and, indeed, it is bad practice to wait for it before interfering, since there is a considerable probability that the tension within the abscess may be sufficient to break down the wall of newly-formed and not too strong adhesions, and the general peritoneal cavity may be thus infected. The abscess develops at first around the appendix, and is, of course, primarily intra-peritoneal. Not unfrequently it bursts into the bowel, and thereby relief is gained without the assistance of surgery; some authorities, indeed, maintain that this occurs in every case of the more severe type which resolves. In other instances it may point externally, either through the anterior abdominal wall, which becomes congested and œdematous as the pus approaches the surface, or through the loin, the pus having invaded the retro-peritoneal cellular tissue. In the latter case, it is sometimes found that the abscess burrows widely up and down the back of the abdomen, and may even extend behind and above the liver, constituting a subphrenic abscess. Not unfrequently it tracks up along the inner or outer side of the ascending colon, and then may get into relation with the under surface of the liver. In other patients, and especially when the tip of the appendix lies over the brim of the pelvis, the pus travels downwards and forms a collection by the side of the rectum; the surgeon must never omit a rectal examination in appendicitis, where the temperature is of such a nature as to suggest the existence of an abscess, and yet no evidence of one can be found. Should it burst into the peritoneal cavity, all the phenomena of perforative peritonitis supervene, probably indicated by a sudden fall of temperature, followed by increased abdominal pain and distension. A fæcal fistula may result from the bursting or opening of any of these abscesses.

In not a few cases the patient's general symptoms improve after the first outbreak; the temperature may become normal, the pain decrease, and the vomiting cease. It is often difficult to be certain whether this improvement is merely temporary, or is the commencement of a true convalescence. Under the former circumstances, *i.e.*, if it is merely an *interval of quiescence*, careful examination will probably reveal some disturbing factor; either the abdominal distension persists, or perhaps hiccough is present, or a well-marked, though localized, tenderness continues, perhaps only to be detected *per rectum*, or the pulse-rate may remain unduly high. After a few days the

temperature begins to rise once more, the focal symptoms become more urgent, and a subacute or chronic abscess forms.

It is often by no means a simple matter to make certain that pus is present; but considerable assistance can be derived from a blood count, which is advisably made each day that the uncertainty persists. We would refer readers back to p. 48 for a full consideration of *leucocytosis;* here we would merely repeat that a leucocyte count under 20,000 is merely indicative of an inflammatory attack well resisted; if suppuration is present, the leucocytes are usually over 20,000.

A complication likely to occur in the more severe types of the disease is pylephlebitis, or infective thrombosis of the branches of the portal vein in the liver. Such would be indicated by recurrent rigors, and possibly by pain and tenderness in the hepatic area. Necessarily it is almost invariably fatal.

(iii.) **Diffuse Septic Peritonitis** is generally due to primary perforation or gangrene of the appendix, and only occasionally to rupture of a localized intra-peritoneal abscess. The onset is usually sudden, and may be followed by symptoms of collapse, from which the patient rallies in a few hours. The abdomen rapidly becomes distended and tympanitic; the muscular wall is held rigidly steady; constipation is absolute, not even flatus being passed; the patient suffers from persistent pain, which is generalized rather than local, and constant nausea and vomiting of the usual peritonitic type. The characteristic picture described at p. 973 quickly develops, and death generally ensues in four or five days. Fever is variable, and in the worst cases is absent; these afebrile cases, in which reactive phenomena are defective, are often associated with a leucopenia.

(iv.) **Relapsing Appendicitis** is the term applied to a condition when an attack passes off, but not quite satisfactorily. There may be a slight persistent rise of temperature at night; or the appendix remains palpable and tender; or some amount of appendicular pain, often of a colicky character, may be noted. In many of these cases the symptoms are due to unhealed ulceration of the mucous lining or to stenosis of the tube. If left alone, a more acute outbreak may supervene, or bacterial invasion of the vessels in the meso-appendix may follow, and serious consequences develop. If an attack of appendicitis does not clear up completely, an operation is always advisable for the removal of the organ.

(v.) **Recurrent Appendicitis** is characterized by repeated attacks of varying gravity in an individual who has been once the subject of the disease. They may occur only at prolonged intervals, or be so frequent as entirely to incapacitate the patient, and are usually associated with the presence of some abnormal adhesion or constriction of the appendix. It is not uncommon for the appendix to become fixed to the sheath of the psoas muscle, and then any excessive movements of the limb may light up an attack. Where stenosis exists, secretions containing bacteria may be pent up behind the constriction, and from time to time the patient suffers from severe pain of a colicky nature without fever, supposed to be due to an attempt

to get rid of the excess of mucus. Such att
appendicular colic. In a few cases the app
obliterated after a time and incorporated in
natural cure being thus established; but n
occurrences are allowed to continue, the pat
abscess, or succumbs to diffuse peritonitis.

Recurrences are more common after th
disease, and it has been calculated that over
jects of a mild catarrhal attack suffer in this
forms recurrence is less common, and it is
recur when suppuration has existed; we ha
where an abscess has developed two and ev
nection with attacks which were separated b
disappearance of symptoms.

Diagnosis.—In a well-marked case the sy
that the diagnosis can never be in doubt.
fever, vomiting, constipation, abdominal rigid
constitute a picture that is quite characteris
ever, often presents symptoms so varied,
protean, that one is never surprised to mee
diverse settings, and many mistakes of diagn
the most skilled clinicians.

Recurrent appendicular pain may be mista
or for the painful attacks associated with dis
kidney (*Dietl's crises*), or *vice versâ*; and the
hæmaturia or irritation of the bladder are ca
effusion or abscess. *Biliary colic* may be sim
and inflamed gall-bladder may closely resemb
which has travelled upwards.

Perforation of the duodenum or even of th
symptoms very similar to those of appendic
matory mischief tracking downwards. The
be referred to the upper part of the abdor
evidence of free gas in the peritoneal cavity
the abdomen on operation, and it is free fron
is that the lesion is gastric or duodenal.
appendicitis, and the appendix is indeed often
The distinction is made by the tenderness
whole course of the colon, and by the passage
Tubal and *ovarian* diseases are recognised on
the fact must not be overlooked that chron
associated with inflammation of the right ov
pain often occur at each menstrual period.

A considerable swelling in the right iliac
repeated attacks due to a matting of the
diagnosis from tuberculous or malignant d
apart from operation. The history may be spe
however, in appendicitis.

In abdominal abscesses the possibility of

must always be kept in mind, as they may present in any part of the abdomen; and it is often only by a careful exploration of the cavity that we can trace the cause to the appendix.

The diagnosis from acute obstruction is noted hereafter (p. 1108).

The **Prognosis** is never absolutely certain, for, as has been well pointed out by many acute observers, the initial symptoms are frequently alike in all the varieties, and hence one can never know what course the case is going to take; as R. Morris, of New York, says, 'The infected appendix is a cap which sometimes snaps, sometimes flashes, and sometimes causes an explosion, and none of us can tell in advance just what is going to happen.' As particularly bad signs may be mentioned a continued high temperature, in spite of rest and careful dietetic measures, or a fall of temperature with increased rate of the pulse. Persistent hiccough is also a bad sign. The existence of a swelling in the iliac fossa is not a bad sign, but rather the reverse. Absence of a localized swelling is due either to a defective formation of protective adhesions, and hence is likely to be noted in the most acute cases, or to the appendix being placed behind the cæcum in a position less favourable to operative measures.

Treatment.—So much has been written on this subject during the last twenty years, that it is extremely difficult to compress even a brief summary of the many facts observed into a necessarily limited space. Formerly perityphlitis was the exclusive property of the physician; but a great change has occurred, and many authorities consider that appendicitis is more justly within the realm of the surgeon, or, at any rate, that a surgeon should always share the responsibility of treatment with the physician. At any moment complications may develop even in what appear to be simple cases, in which immediate surgical assistance will alone hold out any hopes of saving the patient. In America surgery is the recognised treatment for almost every case of the disease, as soon as it is diagnosed; in this country more conservative ideas still persist, but we are glad to note that a more healthy opinion is gaining ground, and that surgical interference is becoming recognised as the most appropriate means of treatment in many instances. At the same time, we are bound to admit that operation during the acute stage does not seem to us to hold out such good prospects as when performed during the quiescent period after an attack, and hence if the patient's safety is not compromised by delay, one would prefer to postpone operation till the acute symptoms have passed away.

1. In the mild catarrhal type of appendicitis, where the temperature does not run above 101° and the symptoms are not severe, all that is required in the majority of instances is to put the patient to bed, and apply fomentations locally; the lower bowel should be emptied by an enema, and if it seems likely that there is an accumulation of irritating fæces within the intestine, *one* dose of castor oil or of calomel may be administered. A fluid, unstimulating diet is all that is permitted, and should there be much vomiting, rectal alimentation may be resorted to. Possibly morphia may be given with

advantage to quiet the patient and check peristalsis, thereby facilitating the formation of protective adhesions; but the less the better, since it tends to mask symptoms.

The question of operation for this mild type of disease can be readily compressed into the three following propositions:

(*a*) If the condition is not showing signs of improvement at the end of forty-eight hours (*i.e.*, on the third day) in spite of appropriate treatment, operation is desirable.

(*b*) If the appendix remains tender and palpable after an attack, and especially if the temperature rises slightly at night, the organ should be removed without delay.

(*c*) As soon as the attack is really quiescent—*i.e.*, generally in nine to ten days—the appendix should be removed. This proposition may not be generally accepted; but it is absolutely logical, and daily experience is emphasizing the conviction as to its accuracy. In the first place, recurrence is common, and the figures given above (viz., 30 per cent.) probably under-estimate its frequency. Then, too, it is impossible to tell which cases will recur and which escape, whilst the recurrent attack is frequently more severe than the first, and we have often known the second or third attack complicated by suppuration. Moreover, each recurrent attack is likely to add to the adhesions present, so that whilst removal after a first attack is an easy proceeding, removal after many recurrences may necessitate a long incision and a troublesome and dangerous dissection, complicated, perhaps, by unintentional perforation of the bowel, or even enterectomy.

Operation in the Quiescent Period.—The muscle-splitting plan suggested by McBurney may well be adopted when it is probable that but few adhesions are present. The incision is an oblique one about 2 to 3 inches long, crossing McBurney's spot or a little below it, and parallel with the outer end of Poupart's ligament, somewhat similar to that for ligaturing the external iliac artery (Fig. 363, C). The external oblique is exposed, and incised in the course of its fibres; the divided segments are held well aside by retractors, so that about 2 inches of the internal oblique muscle come into view. The muscle fibres in this region will run nearly transversely, and both it and the transversalis muscle can be divided by a transverse incision. The introduction of large deep retractors will expose a square or diamond-shaped area of subperitoneal fat or peritoneum about 1½ to 2 inches in diameter. The peritoneum is divided by a transverse incision, and the margins grasped for identification purposes by Spencer Wells forceps. The cæcum will probably present, and is gently withdrawn. The anterior longitudinal muscular band conducts to the appendix, which is freed from adhesions and removed. The meso-appendix is first divided after securing the vessels in it with ligature (Fig. 388, A). The serous and muscular coats are then divided by a circular incision and pealed back like a cuff, leaving the mucous membrane as a narrow tube (Fig. 389). The retraction is carried back so as to enable a catgut ligature to be placed around the tu-

of mucous membrane flush with the cæcum. The distal end is grasped with Spencer Wells forceps, and cut away after protecting the parts below with a strip of sterilized gauze (Fig. 390). The protruding portion of mucous membrane is carefully curetted, and the sero-muscular cuff replaced over it and secured by a ligature (Fig. 391). If this proceeding is carried out carefully, and the mucous membrane secured flush with the cæcal wall, there is no more need to touch it with pure carbolic or the actual cautery (as is sometimes recommended) than in any other operation on the intestine.

All bleeding points having been secured, the cæcum, which has been protected during the operation by a warm wet sterilized cloth, is returned into the abdomen, and the incision in the parietes closed layer after layer by catgut sutures. No drainage is needed.

If, however, it seems probable that many adhesions are present,

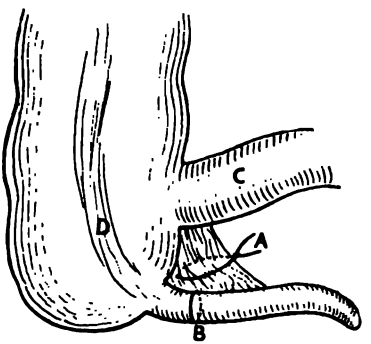


FIG. 388.—APPENDECTOMY.

A indicates the ligature placed on the meso-appendix; B, the situation of the circular incision through the sero-muscular coat; C, the lower end of the ileum; D is placed on the anterior muscular band of the cæcum which leads directly to the base of the appendix.

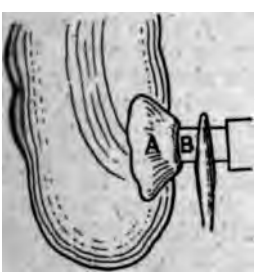


FIG. 389.

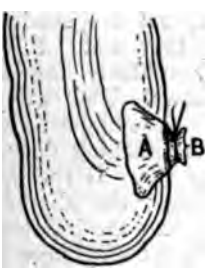


FIG. 390.

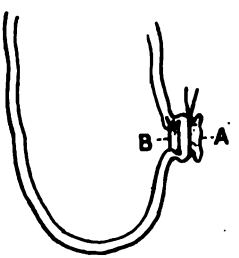


FIG. 391.

AMPUTATION OF THE APPENDIX.

In Fig. 389, A represents the cuff of sero-muscular tissue dissected up, exposing (B) the tube of mucous membrane, which is secured by a pair of Spencer Wells forceps.

In Fig. 390 the tube of mucous membrane (B) has been ligatured close to the cæcum, and the appendix cut away proximal to the forceps.

In Fig. 391 the ligatured mucous membrane (B) is covered in by the sero-muscular cuff (A), which is itself closed by a ligature.

the muscle-splitting operation should be avoided, and the abdominal parietes divided in the line of the cutaneous incision, so as to allow

the wound to be enlarged up or down a
severance of these adhesions may be a mos
procedure, but when once it is effected th
as described above. In some of these mo
operations, it may be desirable to drain th
gauze wick for a short time.

Under any circumstances the patient
weeks to allow the bond of union to beco
all needless strain for some months.

2. In the gravest variety of *fulminating a*
general septic peritonitis, there can be n
hope of recovery lies in immediate operati
of diffuse peritonitis are well marked, this
extreme; if, however, one can anticipate th
mischief, it is possible that a certain perce
saved. Hence, whenever the attack star
collapse, and if the abdomen shows any s
sion in twenty-four hours, and if vomiting
be lost in operating. The abdomen is o
middle line or in the right iliac fossa; th
washed away with sterilized salt soluti
appendix looked for and removed. Drain
by tubes or gauze wicks: one tube pass
and one through the lumbar region; g
amongst the intestines.

3. When an abscess is evidently prese
by fluctuation or by a commencing œde
there should be no hesitation in cutting do
over the œdematous spot, and deepened c
are probably matted together, and cut lik
knife or index-finger may suddenly sink in
a gush of fœtid pus follows. The cavity
to ascertain whether or not the appendix c
should be used, for fear of breaking down
ing the general peritoneal sac. If the ap
found, it is best left alone; the abscess
drainage is provided for, and the incision
the case will go on well, the discharge l
third day, and the remaining sinus will g
tion. Should the appendix, however, pr
removed.

4. There is still, however, a large group
of the above conditions is manifest, and yet
and general, point to the fact that a lesion
present. Some difference of opinion ex
for operation in these cases. We are quit
many instances conservative or medical
bring about a satisfactory result; but this
and, unfortunately, only too many lives ha

an unwillingness to call in a surgeon, except at the last moment. Under these circumstances, even if acute peritonitis has not occurred, the patient is profoundly toxæmic or exhausted by preceding suffering; and hence operative measures are likely to fail through the asthenic condition of the individual, even if the local phenomena are such as can be efficiently dealt with. Personally, we are distinctly in favour of early operation, and the general rule (to which, of course, there are exceptions) which we should suggest as justifiable is that, *if in spite of suitable rest and medical treatment the symptoms, both general and local, are not commencing to abate at the end of forty-eight hours, operation should be undertaken.* The great advantages we would claim for this procedure are: (*a*) That the patient is not in a state of collapse from toxæmia, and hence can stand the shock of an intra-peritoneal exploration without much risk; (*b*) that the appendix can usually be found, isolated, and removed without much difficulty; (*c*) that the risks associated with the presence of pus in the abdomen during this procedure are considerably diminished, since but little pus is likely to have developed at so early a date; and (*d*) that a smaller incision will be required, and hence there will be less likelihood of a hernia developing subsequently. The following conditions indicative of an intra-peritoneal abscess, even if no tumour can be felt, always suggest that an operation is desirable, viz., a leucocyte count above 20,000, especially if maintained for twenty-four hours; persistent distension of the abdomen, a maintained high temperature, hiccough, or a continued high pulse-rate in spite of a falling temperature.

Operation for Suppurative Appendicitis.—The incision must vary somewhat with the physical signs and the site of maximum tenderness. The whole thickness of the abdominal wall is divided, and it is well to make a sufficiently large opening rather than one that is too small; an extra inch of incision may make all the difference between blindly groping in the dark and seeing clearly what one is doing. The general arrangement of the parts is noted, and the peritoneal cavity protected from purulent infection by packing in sterilized gauze; one strip is usually passed upwards along the ascending colon, one downwards into the pelvis, and one internally to protect the small intestines and general serous cavity. The cæcum is then gently lifted from its bed, and the abscess will usually be found behind it. The procedure, of course, must be modified with the actual condition of affairs, but every effort must be made to prevent soiling of the unaffected peritoneum. Whenever possible, the appendix should be removed; it is first freed from adhesions, and the meso-appendix ligatured. If sufficiently healthy, a formal amputation, as in the chronic cases, should be undertaken, but such a procedure is often impracticable. A silk thread is then tied around the base about ¼ inch from the cæcum, and the appendix cut away; the stump is, if practicable, buried by the insertion of two or three sutures into the serous membrane covering the cæcum. Not unfrequently, however, the appendix does not present, and then

it is usually wiser to leave it alone. The ca by swabbing it out, and then carefully pack drain it thoroughly, and yet to protect the may be desirable to introduce a drainage-t opening in the loin. The abdominal incision

The packing is gradually removed in the and after the general cavity has been shut of adhesions, irrigation with salt solution is pe heals by granulation, and when nearly flusl be drawn together by strapping, so as to limi ment of a ventral hernia.

Sequelæ.—A *Fæcal Fistula* may result fro citis when the abscess has been merely treatment undertaken at the same time, or it tion of the appendix from sloughing or yie is usually small in size, and sinuous in its co cases close of itself. Occasionally it is nec laying bare the cæcum in the iliac fossa, and or suturing the opening. Failing that, it ma circuit the cæcum.

A *Ventral Hernia* sometimes follows fro cicatrix in the abdominal wall after an absce drained. Both omentum and bowel, perha adherent to the cicatrix, are found in the pro it may suffice to cover it with the concave others operation is required; adhesions mu down, and often the opportunity can be appendix, if this has not already been acco of the divided muscles are then sought for, buried sutures in the ordinary way.

Affections of the Live

Rupture of the Liver is produced by in walls, such as blows, kicks, or crushes, or broken end of a rib. Penetrating injuries a or dagger thrusts, and the organ may be invol The resulting lesion varies considerably; t torn or contused from a non-penetrating blo sharp cutting implement, in which case so trunks are likely to be divided; a bullet son total disorganization. The amount of injury on the condition of the organ; if it is firm seceive little damage from a blow which w riderable harm, whilst if it is enlarged and fa

The chief **Symptoms** are shock, which is pain and tenderness in the right hypochond of loss of blood. The last is, perhaps, the m its severity depends to a large extent the

capsule remains intact, and then, although there is considerable intra-glandular ecchymosis and laceration, no free blood escapes into the peritoneal cavity. Such a lesion is not unlikely to be followed by an abscess of the liver. When the capsule is torn, intra-peritoneal hæmorrhage is sure to ensue; if slight, the patient, though suffering from all the phenomena characteristic of loss of blood, may recover, the blood being absorbed, and the wound in the liver cicatrizing. This process is usually attended by a certain amount of jaundice and some vomiting, whilst the urine is also tinged with bile-pigment. Well-marked pyrexia may follow the initial shock, and the abdominal wall is held rigid. In other cases, the blood collects at first in the upper part of the abdomen, but gradually extends downwards; if the bowel is uninjured, recovery may ensue, but not uncommonly there is some associated contusion of the gut wall, through which intestinal bacteria find their way, giving rise to a localized or general peritonitis. Of course, in the more severe lesions, where perhaps the left lobe is entirely torn off or a portion hopelessly contused, death from hæmorrhage is almost certain to ensue in a very short time.

The **Diagnosis** of hepatic rupture turns mainly on the history of the accident, the situation of the blow, and the resulting symptoms. Evidences of intra-peritoneal bleeding, associated with pain in the right side, are extremely suggestive. It must not, however, be forgotten that the passage of a hansom cab or other vehicle over the body may give rise to much shock, and to considerable local pain and tenderness, and yet no serious mischief need have happened to the liver.

The **Treatment** in the more simple cases consists merely in careful expectancy, the surgeon holding himself in readiness to interfere should any untoward symptoms supervene. The patient is kept quietly in bed; ice may, if necessary, be applied to the side, the diet is limited to fluids, and the bowels emptied by enemata. In the more serious cases, where the diagnosis of ruptured liver is tolerably certain, an exploratory laparotomy should be undertaken, and an attempt made to deal with the wound. Possibly a median incision is as good as any, since the left half of the liver often bears the brunt of the injury. Outlying ragged portions of the gland may be totally removed, preferably by the cautery, though one usually has to depend upon plugging the wound with gauze in order to effect hæmostasis. Clean linear cuts may be sutured with silk, but there is considerable difficulty in preventing the stitches from tearing out of the friable hepatic tissue; it is wise to insert all the stitches first, taking up a good margin of the gland substance before attempting to tie any. The wound is then carefully closed by the fingers, and the sutures slowly and gently tightened. Very shallow wounds which it is impossible to stitch or plug satisfactorily may be seared with the cautery so as to stop bleeding, and then a gauze drain is placed over them, and brought out of the external wound.

Abscess of the Liver is due to a variety of causes.

1. ***Multiple Abscesses*** develop in cases of pyæmia, whether the emboli are carried by the hepatic artery or by the portal vein. In

the former case, the condition arises as a pyæmia of systemic origin; in the latter, mischief is located in the area of distributio in the intestinal canal. Thus, pylephlebiti uncommonly met with in appendicitis, an fever, whilst suppurating piles may also lea

2. *Suppurative Cholangitis* is another caus the liver. It consists of an inflammatory ducts and passages, and is due to the spre intestine, or occasionally from the gall-bla The biliary ducts in the liver become enor with a mixture of bile and pus which look It is accompanied by pain over the gland ar of pyrexia, but rigors are not present. T jaundiced, but bile may be found in the urir avail, but if a diagnosis can be made, and been already incised, it may relieve tension

3. Hydatid cysts may suppurate, and req abscess of the liver.

4. The more important abscesses, from those which, from their size, demand opc may result from traumatism in the way st in connection with hydatid cysts, but more known as *tropical abscess*. The latter usu who have travelled in the tropics, and 75 attributed to dysentery. The exact mode been fully worked out, but it seems probab of embolic origin. They are most frequent the right lobe, but, of course, any part of the Though often single, the cavity is freque that several original foci of suppuration ha of the ordinary pyogenic organisms may b not unfrequently the *B. coli* is present. I *coli*, an organism which is found in the dysentery, has been discovered. Occasion causative organisms having probably been result of the chronicity of the process. Th disintegrating hepatic tissue in acute case cicatricial wall in the more chronic forms abscess the limiting membrane may be as to is sometimes of the ordinary type, but not un in colour, somewhat like chocolate, and of

The **Symptoms** are in some instances ext perhaps dying of peritonitis due to its rup having ever been suspected. The individu sense of weight and fulness in the right hy more acute cases this may be accompan localized tenderness over the whole hepati also referred to the right shoulder. A certa

turbance occurs, the degree of which depends on the rapidity of formation of the abscess; in the more acute forms the temperature is high and rigors may be present. The pyrexial phenomena are associated with loss of appetite, rapid and well-marked emaciation, and perhaps a certain amount of icterus, though the latter is not usually a prominent phenomenon. On physical examination a more or less evident enlargement of the liver will be detected, with, perhaps, a feeling of elasticity, or even of fluctuation at some spot. The dulness often extends up towards the thorax rather than downwards, though when the abscess is situated not far from the free margin of the liver, this is not the case. A doubtful diagnosis can sometimes be confirmed by the aspirator or hypodermic needle, but this should not be utilized unless one is fully prepared for immediate operation in the case of pus being found. Manson directs that the aspirator needle should be introduced in the following situations: (1) In the right axillary line through the seventh or eighth costal interspace; (2) just below the ribs in the right nipple line; (3) immediately below the lung in the line drawn downwards from the angle of the right scapula.

Left to itself, several distinct courses are open for the abscess to follow: it may become adherent to the anterior abdominal wall and point in the epigastrium, its onward passage being indicated by congestion and œdema of the parietes; it may open into the peritoneal cavity, or into one of the hollow viscera, such as the colon or duodenum; or, again, it may travel upwards, burrowing through the diaphragm, and either bursting into the lung, its contents being expectorated, or into the pleural cavity, leading to an empyema. Occasionally it remains passive as a chronic encysted abscess, and then the walls become very thick. One of us recently opened an hepatic abscess which had been diagnosed by a hypodermic needle twelve years previously, and left alone. It contained about 2 pints of pus, and the walls were fully ½ inch thick. The patient came under observation because the swelling was becoming more prominent, as the result of increased intra-abdominal pressure, due to pregnancy.

Treatment.—*Aspiration*, repeated once or twice, has been frequently employed, but is of little value, and not a few cases are on record in which septic peritonitis or pleurisy has followed the introduction of the needle from the front or side respectively. Experience proves that the usual law of treating suppuration ought to be strictly obeyed, viz., that the abscess should be opened and drained. If pointing in front and adherent to the parietes, there is no difficulty or danger in making an incision over the most prominent spot and laying the cavity open; it is then well flushed out and a drainage-tube inserted. If on dividing the abdominal parietes it is found that the liver is not yet adherent, it was formerly thought best to plug the wound with sterilized or antiseptic gauze, or to introduce sutures between the liver and the parietal peritoneum so as to determine the formation of adhesions to such an extent as to shut off the general peritoneal cavity; in a few days the abscess could then be opened with safety. At the present time the operation is done at one sitting with precautions of

a similar type to those taken in dealing
abscess connected with appendicitis. Th
must be carefully protected by sterilized ga
pus, and the assistant must keep the pariet
the hepatic tissue. It may be possible
through the liver substance, securing it t
toneum; otherwise one must trust to caref
ing the abscess, it is usually advisable to w
with advantage be repeated subsequently.
inserted, and packed around with gauze to
vasation.

When the abscess is in its most common
of the right lobe, it is often most satisfact
side; a similar proceeding is sometimes nee
been opened from the front, and does not dr
is made a little behind the mid-axillary line t
intercostal space, and a portion of one of th
The pleural cavity is opened, and the costal
to that portion which covers the diaphragi
this structure lies nearly vertical in this pos
culty is experienced in shutting off the gen
diaphragm is then divided, and not unfreque
is opened; it must be carefully protected by
the liver incised; less commonly adhesions
or a bare area of the liver may be found, th
be withdrawn and the abscess opened.

Hydatid Cysts occur in the liver more fre
part of the body. For general details as
Tænia echinococcus and the structure of hydat
produce a localized painless enlargement of
ing in size from a small marble to a child's
defined if superficial, but not so if place
usually filled with fluid and daughter-cells.
tinguished, and a hydatid fremitus or thrill
sion of the contained daughter-cysts) may
palpation. The diagnosis is easily made if
lower border, but when deeply embedded
exceedingly difficult, and the tumour can o
certainty from carcinoma or syphilis by the
preferably by an open exploration. The ch
drawn from a hydatid cyst is at once conclu
gravity, viz., 1007 to 1009, slightly opale
and a trace of salt; the presence of sco
pathognomonic feature.

Terminations.—The cyst may remain late
actually dry up and form a mass somewha
to the death of the organism; or it may bu
different directions, with or without suppura
externally through the abdominal parietes

cavity, causing fatal shock and in many cases peritonitis; or into the stomach or intestines, spontaneous cure usually resulting; or it may penetrate the diaphragm, and the contents be expectorated, or set free in the pleural cavity, causing a rapidly fatal pleurisy. It has been known to open into the pericardium, or even into the hepatic veins, the contents then being impacted in the right auricle; in both cases immediate death resulted.

Treatment.—The best plan of dealing with a hydatid cyst is to lay it open either through the anterior abdominal wall, or through the costal parietes and diaphragm, to empty it of its contents, and if possible to enucleate the lining wall or endocyst, which is often but loosely connected to the fibrous ectocyst. This is usually accomplished at one sitting. Similar precautions as to protecting the peritoneum are taken as for an abscess. When the surface of the liver is exposed, it is advisable to puncture the cyst first with a trocar and cannula, so as to reduce the tension within it. It is then incised freely and the loose daughter-cysts removed. This is facilitated by flushing out the cavity with sterilized salt solution. The endocyst is removed either by enucleation with the fingers or a blunt dissector, or it may be possible to detach it by irrigation, the nozzle of the irrigator being inserted beneath it. If enucleation is completely successful, a gauze packing is introduced into the cavity thus formed, and cicatrization is allowed to proceed. If, however, part of the lining wall is left, a drainage-tube must also be introduced, and the cavity subsequently irrigated at each dressing.

No attempt should be made to remove the fibrous ectocyst, as it is closely connected with the liver substance, and grave hæmorrhage might follow any interference with it.

Formerly *aspiration* and *electrolysis* were largely employed in the treatment of this affection. It has been found, however, that although a considerable percentage of cases could be cured in this way (more than a half), yet that it was not unaccompanied by risk of peritonitis, and that recurrence was often observed. Moreover, some of the fluid not unfrequently leaked into the peritoneal cavity, and probably from the absorption of some toxic product present led to urticaria, and sometimes to even graver phenomena of poisoning. Electrolysis merely acts by producing a puncture of the cyst wall and consequent leakage. Both of these methods should be entirely discontinued.

A suppurating hydatid cyst is dealt with according to the same rules of treatment as hold good for abscess of the liver.

Tumours of the Liver are rarely primary. Secondary sarcoma and carcinoma are by no means uncommon, but of course nothing can be done for them. A few cases are on record of removal of a tumour or gumma together with a portion of the tissue of the organ, but such must necessarily be a matter of such rarity that we cannot spare space to discuss it.

Affections of the Gall-Bladder and B

Rupture of the Gall-Bladder results from crushes, kicks, etc., whilst it may also be p wounds or bullets; occasionally it may follow as from a large impacted gallstone. Blood quence extravasated into the peritoneal cavi but if any inflammation of the biliary pass organisms are sure to have found their way i thus complications may readily ensue. If a bile escapes suddenly into the peritoneal sac, tain to follow, whether organisms are prese irritating nature of the fluid; jaundice is also tion of bile by the peritoneum, and it may al A more gradual escape of the secretion w formation of a localized intra-peritoneal absc associated with jaundice and probably clay penetrating wound bile and blood will esc septic peritonitis is almost sure to follow.

The immediate **Symptoms** are those of s chondriac pain, and this will be succeeded b or by the formation of a localized intra-perit with jaundice. When the existence of suc **Treatment** always consists in an exploratory within the abdomen is removed with swab the gall-bladder carefully examined. Shou be found, it is perfectly feasible to close it by should, however, be passed down to the lesio provide a means of drainage should leakage rupture will necessitate removal of the gall-bla of the wound may be stitched to the abdomin fistula thus produced. Should the comm divided, the ends should be closed by su enterostomy undertaken; a small wound in t

Cholelithiasis is the term applied to the pre or biliary passages of **Gallstones**. These co of cholesterine, held together by mucus and ment; they are soluble in chloroform. Whe their specific gravity is a little higher than t when immersed in it they sink; after drying, to float. The number present varies immens large one exists, which is more or less barrel-s frequently they are multiple, scores or hund are then usually faceted, and with a satin-li they have lain long in the gall-bladder, they brown or almost blackish colour.

The **Origin** of gallstones is not yet fully und no doubt that they are primarily due to an in the wall of the gall-bladder or biliary passage

formed by the lining epithelium. Their usual location is the gall-bladder or the lower biliary passages, but they can also develop in the ducts within the liver, especially in cases where the hepatic derangement has been of long standing. They occur most commonly in women who have suffered from dyspepsia and constipation, and may be associated with cancer, either as cause or effect. In a case dealt with by one of us, the origin of the trouble seems to have been the swallowing of a pin many years previously, which worked its way into the gall-bladder, set up an inflammation which resulted in the formation of calculi, and only appeared again after a successful operation, when sixty-six stones had been removed.

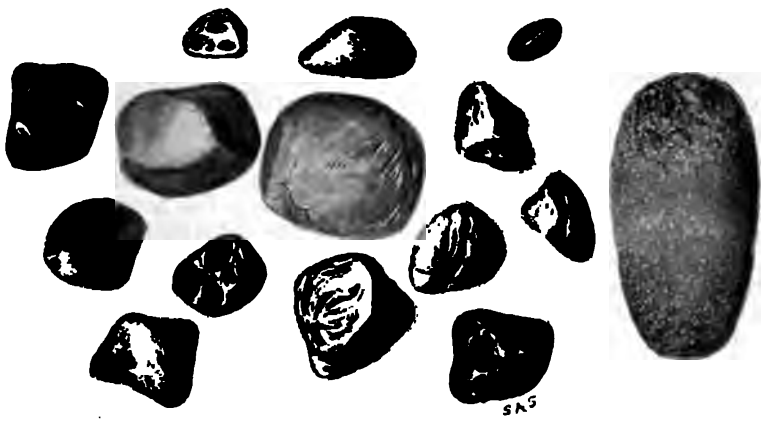


FIG. 392.—VARIOUS TYPES OF GALLSTONES.

Those on the left are of the usual type—not of great size, and faceted; that on the right was a large stone, a little less than the actual size, removed from the cystic duct of a patient who also had carcinoma of the hepatic flexure of the colon.

The **Symptoms** produced are extremely variable. The fact that they are frequently found unexpectedly in the post-mortem room suggests that they may remain latent for years, and only cause trouble when attempting to escape, or if associated with some inflammatory disturbance. Their occurrence is usually preceded by dyspeptic phenomena, which have perhaps lasted for years, and by constipation. Some pain is complained of in the right hypochondrium, but possibly nothing very serious is noted, until a physical examination reveals the distended gall-bladder, which forms a tumour projecting from under cover of the ribs, usually the 8th or 9th, and tending to enlarge downwards towards the umbilicus: it is usually firm, elastic, and perhaps fluctuating; it moves with the liver during respiration, and there is never intestine in front of it. Such a condition often yields to medical treatment; the diet has to be carefully regulated, and a sufficient amount of exercise ordered. Alkaline purgative medicines

3. A gallstone does not always escape into the bowel; it may become *impacted*, and then gives rise to a train of tolerably characteristic symptoms, which vary somewhat with the site of obstruction. If the *cystic* duct is blocked, there is severe pain in the side, and perhaps distension of the gall-bladder with mucus (*hydrops*), constituting a tumour which can be felt, but there is no jaundice. If the calculus is lodged at the *junction of the common and hepatic ducts*, there will be intense icterus, but the gall-bladder is not necessarily distended; the liver, however, is likely to be enlarged from engorgement with bile. When the stone is impacted in the *common bile-duct*, the jaundice is intense, but the gall-bladder is usually small. The pain may be slight, but is often very severe. Generally the stone lodges close to the intestinal end of the duct in what is known as the ampullā of Vater; it may then ulcerate through into the bowel without much difficulty, but not unfrequently gives rise to an associated pancreatic inflammation. If impacted higher up, it may work through into the duodenum or colon by a process of ulceration, or may escape into the retro-peritoneal cellular tissue, leading to an abscess; or, again, it may open the peritoneal cavity, and thus cause acute peritonitis.

Operative Treatment of Cholelithiasis.—The conditions which may call for operation in the course of a case of gallstones are as follows: (*a*) For recurrent attacks of biliary colic, which cannot be prevented by medical treatment; (*b*) for persistent jaundice; (*c*) when the gall-bladder can be felt enlarged and tender; and (*d*) for acute cholecystitis.

Cholecystotomy consists in opening the gall bladder for the removal of calculi, or for purposes of drainage. It is wise in all operations on the biliary passages to introduce a firm sandbag beneath the patient's back, as thereby much better access is given. The incision runs parallel to the costal margin on the right side, and about 1½ inches from it, extending upwards as far as the middle line (Fig. 363, B); some authorities, however, recommend a vertical incision on the outer side or through the substance of the rectus. The peritoneum is opened and the gall-bladder sought for, any adhesions present being carefully divided; it will sometimes happen that these are so abundant as to prevent the surgeon from continuing the operation, the risk of opening the bowel by mistake being too great. The liver is drawn up, and the intestines are pressed downwards out of the field of operation by means of abdominal cloths held in position by a broad retractor. The general peritoneal cavity is thus carefully guarded from infection. If the gall-bladder is much distended, it is advisable to tap it with a trocar and cannula, and withdraw the chief portion of its contents; the opening is then enlarged sufficiently to allow of the introduction of a scoop, or even of the finger, and by this means the calculi are removed. The bile-ducts are carefully examined both by the finger passed inside as far as possible, and outside along their whole length, and by means of a long probe passed down the duct. If the interior is tolerably healthy,

Cholecystectomy, or removal of the gall-bladder, may be necessary for traumatic lesions, and for malignant disease, whilst it is sometimes employed after cholecystotomy in order to prevent any new formation of gallstones. The bladder has to be isolated, and may then be cut away, the divided end of the duct being secured by a double row of sutures, or by a ligature as after removal of the appendix. As much of the peritoneal covering as possible must be saved in order to cover over the parts.

Affections of the Pancreas.

The pancreas is an organ which has only recently received much attention from surgeons; its depth and anatomical relations explain the neglect with which it was treated for so long. At the present time its affections are being studied by surgeons with a keen interest, and considerable operative activity is being directed towards it. There are two chief methods of approaching it: (1) The trans-peritoneal, in which the abdomen is opened in the middle line above the umbilicus; the gland is reached either above the stomach by dividing the small omentum, or by traversing the great omentum just below the great curvature of the stomach, or by opening through the transverse meso-colon. (2) The retro-peritoneal method consists in an incision below the last rib in the lumbar region, but only the head or the tail is exposed by this procedure.

There are two chief risks associated with pancreatic lesions or operations: (i.) The organ is very freely supplied with blood, and it is extremely difficult to ensure hæmostasis. Ligature of the pancreatic tissue causes necrosis, and from the necrotic tissue ferments are set free which act injuriously on the tissues around, and predispose to further hæmorrhage. Deep stitches and effective tamponade can alone be relied on in this direction. (ii.) The leakage of pancreatic juice is a serious danger to the patient in that it is likely to determine necrosis of fat wherever it spreads; hence foci of fat necrosis may be found scattered extensively through the omentum and mesentery in all acute pancreatic lesions. Moreover, it acts most prejudicially on the peritoneum, and induces either an aseptic peritonitis and intestinal paralysis which may prove fatal, or determines an infective peritonitis if bacteria are present.

Wounds of the Pancreas are due to direct violence applied to the epigastrium, and may result from penetrating or non-penetrating injuries. Necessarily, they are usually accompanied by lesions of other viscera, such as the stomach or duodenum, and it is important that surgeons should remember the necessity for examining this viscus in any traumatic condition in the neighbourhood. Deep sutures and tamponade must be used in all cases where solution of continuity has occurred, the latter being needed not only as a hæmostatic agent, but also in order to drain away any leakage of pancreatic fluid. Prolapse through an abdominal wound has been recorded in a few cases, the organ having been almost entirely

present, and a tender spot a little above the umbilicus. Diabetes may arise if the inflammation is parenchymatous; offensive diarrhœa with undigested fat in the stools and rapid wasting are also suggestive symptoms. Operative treatment may be of value, since pancreatic or biliary calculi may be found obstructing the duct; apart from this, benefit has certainly been derived by cholecystostomy and drainage of the biliary passages.

Cysts of the Pancreas have been observed and treated in so many cases since 1887 that their characters are pretty clearly known. Simple complete obstruction to the duct has been proved experimentally not to be a sufficient cause for the disease; some pathological condition of the epithelium must also be present, preventing the re-absorption of the retained secretion. Slight traumatism is a not uncommon cause, and a cyst may develop as a sequela of an attack of inflammation which has quieted down. The fluid within is usually turbid and brownish from admixture with blood, odourless, and with a fairly high specific gravity; it is of an alkaline or neutral reaction, and contains albumen, but no urea or bile; it is capable of peptonizing albumen, of emulsifying fat, and of converting starch into sugar. The cyst can be felt as a rounded, tense, fluctuating or elastic swelling, placed deeply in the abdomen, immoveable, and perhaps transmitting the aortic pulsation. The relations of a cyst to the stomach and transverse colon vary; the cyst primarily forms behind the stomach, but when it attains any size it projects anteriorly, and then most commonly approaches the abdominal wall below the stomach and above the transverse colon. More rarely it presents above the stomach, or below the transverse colon.

Pancreatic cysts usually develop in middle life, occurring most frequently in men; emaciation is sometimes marked, since a good proportion of the fatty food passes away in the motions; the skin is often dirty, earthy, and unhealthy-looking. Treatment consists in laying the cyst bare, the surgeon usually finding his way to it between the stomach and transverse colon. Its contents are then drawn off by trocar and cannula, and arrangements made for drainage. A large tube is inserted, either through the front, or from the back by the side of the vertebræ. The skin around usually becomes irritated by the discharge, owing to a process of digestion. The prognosis with such treatment is good, although healing may be slow, and a permanent fistula may develop. Körte collected 101 cases operated on, and of these 5 died, 4 from the direct result of the operation, 1 from infection of the fistula.

Carcinoma of the Pancreas is met with either as a primary growth, or secondary to a similar disease of the stomach or pylorus. It is usually, but not invariably, of a scirrhous type, and may lead to distension of the stomach from pressure on and constriction of the pylorus, and to jaundice and ascites by involving the bile-duct and portal vein. In one or two cases removal has been undertaken with success, although an exact diagnosis was not arrived at before the operation. Sarcomata and other tumours are very rare.

ent, where advisable, consists either of splenectomy, or, if cysts, of incision and drainage.

y, or extirpation of the spleen, has been undertaken for a onditions, and its value and position as a surgical pro- ow pretty well established. For traumatic lesions it is d justifiable. For primary hypertrophy, and for malarial , it may be performed if serious discomfort is being cannot otherwise be remedied. If drainage fails to cure n may be performed. If malignant disease is diagnosed arly, the organ may be removed. Splenectomy for leuco- s absolutely unjustifiable, all the cases operated on

The *operation* is performed through any suitable incision length. The peritoneum having been opened, the organ examined, and if extensive adhesions are present, the be wise to desist, since fatal hæmorrhage is very likely n any attempt to break them down. If the organ is freely is carefully drawn out of the abdomen, the pedicle being secured temporarily by pressure forceps. It is then cut ie pedicle tied after transfixion with silk ligatures, the h are cut short and returned into the abdomen.

ill certainly predispose to this condition, and, moreover, oubt as to the tendency of hernia to run in families. length of the mesentery or omentum has also been a causative factor; but, although it may have some n other conditions are present, it can *per se* have but (*e*) Congenital phimosis, by inducing forcible acts of cts as an exciting cause. (*f*) Congenital apertures linea alba or linea semilunaris, especially opposite one lar intersections in the rectus, and through these one al hernia may develop. (*g*) The umbilicus is sometimes eveloped at birth, permitting the viscera to protrude of the umbilical cord (congenital umbilical hernia). hragm is also occasionally defective, allowing the her viscera to find their way into the thoracic cavity.

uses.—Hernia may result from any condition which o weaken the abdominal parietes, or to increase the al pressure. Thus, all violent exercise, especially when tent nature and accompanied by excessive straining, as y weights, may determine its occurrence, and the more ividual is forced to maintain the upright position, or nds or girths round the abdomen. Pregnancy stretches l walls, and parturition, by inducing violent muscular nay originate a rupture, either through a split in the hrough the crural canal. Prolonged and severe bron- ours the occurrence of a hernia by the increase of intra- essure due to coughing, whilst the straining to pass s of enlarged prostate or stricture may act in a similar ronic constipation is a frequent factor in its production, the patient makes use of a closet with a high seat, nguinal canals are left unprotected; in uncivilized races, ition is performed in the squatting posture, the lower bdomen is supported by the flexed thighs, and hernia is ion. Patients with weak and bulging inguinal regions antage use a low commode. In old and weakly people, cause may be found in the slipping downwards of the ttachment, causing the intestines to occupy the lower bdomen rather than the upper, so that the former bulges pelvic brim. This is possibly due to weakening or the unstriped muscular tissue which normally exists ritoneum, passing from the posterior abdominal wall to le mesentery; it is sometimes called the *muscle of Treitz.* so a predisposing factor to hernia, the accumulated fat ed in the omentum, mesentery, and subperitoneal tissue, ig the intra-abdominal tension.

–A hernia consists of a sac and its contents, the sac l of peritoneum, perhaps thickened by additional cover- from the abdominal parietes, and the contents being the cera.

peritoneal investment of an acquired hernia, is in the

, if irreducible, obstruction may ensue from impaction and if its vessels are constricted strangulation super- lescription of these conditions, see p. 1087. The small :h more frequently involved than the large gut. The :l protruded varies from a few inches to several feet. is found in a hernial sac, the condition is known as an ong as it remains reducible, it is likely to retain its ; but when large in amount, and especially if irre- omes thickened, brawny, and matted together to such lmost to constitute a solid tumour; it is often the seat e deposit of fat, and in consequence of this overgrowth ne irreducible, even when no adhesions are present. sometimes develop within it as a result of effusion be- l surfaces. In some cases openings are found in it of to allow the gut to pass through and become strangu- omentum and bowel are present in the same sac, the nown as an *entero-epiplocele*.

sometimes occupies a hernial sac, either in aggravated rniæ, or in children with congenital hernia; it has nd in a hernia on the left side. Since the cæcum has mplete serous covering and usually a mesentery, it is le, and may pass into a hernial sac in the same way as eable part of the intestine. On the other hand, a few ases have been related in which the serous envelope te in a so-called 'cæcocele.'

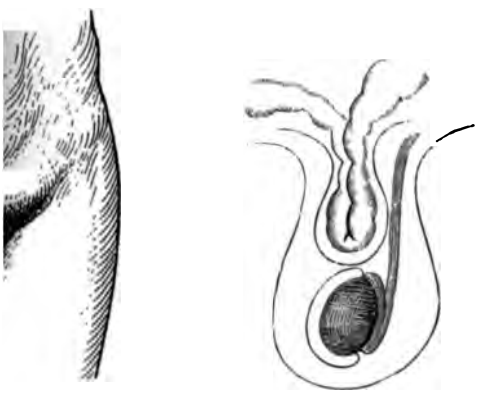
rm Appendix is occasionally found in a hernial sac on It is rarely free, but generally fixed by adhesions and The hernia is more painful than usual, and on palpation can sometimes be felt enlarged and tender, pressure eferred to the umbilicus. The patient is likely to give current attacks of inflammation in the sac.

may be associated with a hernial sac in two distinct ually in the inguinal region. (*a*) The fundus may be wards by the traction of the peritoneum, when the tained a colossal size. There is then only a partial estment, the bladder lying outside the sac, and being . Considerable irritability of the viscus is induced, and, ation of urine in the displaced part, a phosphatic con- rm therein, and such has even been removed by incision rotum. (*b*) Occasionally a saccule of the outer wall of comes adherent to the peritoneum, and is drawn down inguinal canal; its presence may be suspected if a small ciated with much vesical irritability. Such a protrusion y of thickened mucous membrane and submucous tissue, of muscular fibres; it is very liable to be laid open if or the radical cure is undertaken. If such an accident pening must be at once closed by sutures, which should the mucous membrane, otherwise phosphatic concre- n on the portion of suture exposed in the bladder, and ent trouble.

uscle and fascia, representing and extending from (*c*) the infundibuliform fascia derived from the and (*d*) finally, a layer of subserous tissue vary- d closely surrounding the peritoneal sac. In i does not attempt to recognise these different one of importance being the cremasteric, the which are often evident, and serve as a useful

fferent forms of oblique inguinal hernia, viz., the ital, and the infantile or encysted.

uinal Hernia (Fig. 394) is one in which the sac eritoneum protruded from within the abdomen. s in size, and finds its way along the cord to the



OBLIQUE IA.

FIG. 394.—DIAGRAM OF ACQUIRED INGUINAL HERNIA, SHOWING SEROUS SAC WITH INTESTINE COMING DOWN TO THE TOP OF THE TESTIS.

sually extends as far as the head of the epididy- size it may overlap the testicle, which lies be- ures of the cord are frequently spread out over ding cases the internal ring is dragged down- nd often lies behind the outer, and thus it may n operation, to determine whether any particular blique. In many early cases the sac is so dis- is to suggest that the condition was really due to e uppermost part of the funicular process.

al Hernia (Fig. 395) is due to non-closure of the peritoneum, which passes down to the scrotum is usually obliterated completely except below, tunica vaginalis. As already mentioned, the ssarily appear in infancy, its occurrence being puberty, or when the patient has to undertake orm of hernia is much more frequently met with

losis is usually associated with this condi-

sted Hernia is one occurring in individuals in cess, although shut off from the abdominal tent below, communicating with the tunica extends, in consequence, as high as the in- A). The hernia has a distinct sac, which open process, or invaginates it (Fig. 396, B recognised except on operation, when the the tunica h reaching nmunicate al cavity; g this, the . is found : so likely day, when

l Hernia

h, though ternal ab- travelled e inguinal enital, and e oblique the inner ery, which inctly over upper wall.

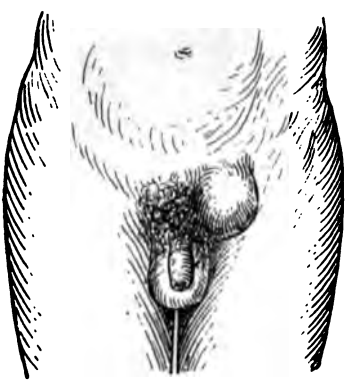


FIG. 397.—DIRECT INGUINAL HERNIA.

The hernia traverses the space triangle, which is bounded internally by the tus muscle, by the deep epigastric artery part's ligament below (Fig. 398). The rtery passes across this space in a direction ler, dividing it into two parts, and according otrudes through the inner or outer segment, rnal or external direct hernia (Fig. 398, tic cord usually lies to the outer side of a stituent elements are never spread out over e form. A direct hernia is rarely found in is often a considerable amount of subperi- e sac.

ernia is very similar in nature to the acquired t it is placed to the inner side of the deep shes in front of it the transversalis, instead scia. It lies to the outer side of the conjoined mplete covering of the cremaster muscle.

ernia issues from the abdomen to the inner pogastric artery, rupturing or pushing before , which in such a case is poorly developed. me as for the external variety.

Interstitial Hernia is the name given to an inguinal hernia which does not follow its usual course, but develops in some abnormal relation to the abdominal wall. Three varieties are described: (*a*) Where a sac exists between the transversalis fascia and the peritoneum (*intra-parietal* form, or *pro-peritoneal* hernia), either with or without a hernia in the usual position; in the former instance one form of 'hernia en bissac' is produced. This abnormal pocket of the sac is found either between the symphysis pubis and the bladder (hernia inguinalis ante-vesicalis), or it extends outwards towards the iliac fossa (hernia inguinalis intra-iliaca). As no external swelling is caused by this condition, it is usually impossible to recognise its existence prior to

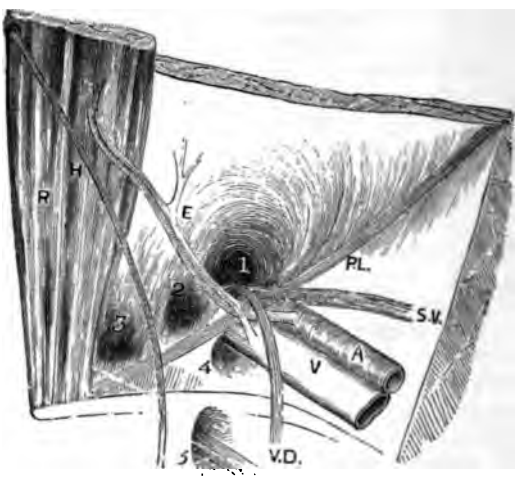


FIG. 398.—ABDOMINAL WALL FROM WITHIN, TO SHOW HERNIAL APERTURES.

A, V, Femoral artery and vein; S V, spermatic vessels; P L, Poupart's ligament; V D, vas deferens; E, epigastric vessels; R, rectus abdominis; H, obliterated hypogastric artery; 1, internal abdominal ring; 2 and 3, sites of external and internal direct hernia in Hesselbach's triangle; 4, crural ring for femoral hernia; 5, obturator foramen and vessels.

operation; occasionally it is the cause of a continuation of the symptoms of strangulation, when apparently successful taxis has been performed, owing to the strangled bowel being pushed backwards from the superficial into the deeper portion of the sac. (*b*) An abnormal expansion or bulging of the sac is situated between the internal and external oblique muscles (*inter-parietal* form). A swelling is thus produced in the region of the inguinal canal, covered by the external oblique aponeurosis, and tending to spread upwards and outwards parallel with Poupart's ligament. The sac is often shaped like an hour-glass, a more or less complete septum existing at the level of the external abdominal ring, formed either by adhesions or by a mass of adherent omentum. The usual downward course of the hernial contents is thus prevented, and the sac yields laterally above the site of

, and passes between the muscles. (*c*) The hernia
l from the external abdominal ring, but travels out-
part's ligament, somewhat simulating a femoral hernia
ariety). This form is generally associated with late
testis, and a contracted state of the scrotum, so that
the hernia, which is always of a congenital type, to
igh, and be guided by the fascia in the direction in-
ase of this character operated upon a few years back,
found lying close to the anterior superior iliac spine.
iculty in recognising such a condition.

an inguinal hernia do not require much special notice
re already described the general clinical features of a
6). In the early stages, where merely a bubonocele
is noted in the course of the inguinal canal, which
the patient coughs; it is best detected by a finger
the external ring into the canal. When it descends
m, the swelling increases in size from above down-
he oblique variety is continuous with the fulness in
nal. The structures of the cord are masked by the
hernia, but the testicle is to be more or less distinctly
r and back part of the swelling. When of the direct
d lies to the outer side, and although the hernia can
g from the external ring, it passes directly backwards,
fulness along the course of the canal.

ia is usually met with in the male sex, the oblique
nore common in the young, and the direct in elderly
e female sex it is rare, except in girls and young nulli-
; in such cases it is almost always congenital, passing
n along the canal of Nuck, but rarely attaining any
ze.

s of an inguinal hernia is a tolerably simple matter if
ated by any other condition; it may, however, be diffi-
l-standing cases it is often impossible to distinguish
iety from the direct. The conditions for which it may
e best considered in two groups.

e hernia is still incomplete and in the bubonocele stage,
tinguished from the following: (*a*) *Encysted hydrocele*
ich is recognised by its smooth globular outline and
ie impulse on coughing is less distinct, and, although
e in the canal, the hydrocele cannot always be entirely
e abdomen, whilst the characteristic gurgle of a hernia
tion on the testis, moreover, fixes the tumour, and
obile. The exact limitation of the upper end of the
an be reached, is very characteristic of a hydrocele.
bscess originating in the abdominal parietes, or within
r pelvis, will sometimes point through the external
. In such cases, although there is a distinct im-
ing, and although the swelling is reducible, it has
e outline and characteristic sensation of a hernia,

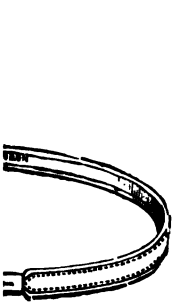
being usually soft and fluctuant. Other evidences pointing to the existence of the original disease may also assist in determining the nature of the swelling. (*c*) *Enlarged glands in the groin* which have become adherent to the external oblique are sometimes mistaken for a hernia, owing to the fact that on coughing a distinct impulse is communicated to them; it is, however, merely heaving in nature, and not expansile, whilst on digital exploration of the inguinal canal the absence of a hernia may be readily ascertained. (*d*) A *testicle retained in the inguinal canal* is recognised by that side of the scrotum being empty, and on pressing the swelling testicular sensation may be elicited. The rounded upper end of the testis can often be detected. (*e*) *Tumours consisting of fat or other tissues* are occasionally seen in the inguinal canal, but are characterized by the strict limitation of their upper border, and usually by the absence of a distinct impulse on coughing. On the other hand, as described elsewhere, a mass of fat simulating a lipoma is sometimes present, resulting from a protrusion of the subperitoneal tissue, a hernial sac being found embedded in its interior. (*f*) *Hæmatocele of the cord* is recognised by a history of injury, the presence of pain and ecchymosis, and the absence of an impulse on coughing, whilst reduction is impracticable.

2. *When the hernia extends into the scrotum*, less difficulty is experienced in its diagnosis. By examination of the cord immediately outside the external abdominal ring, all purely scrotal swellings, such as hydrocele or sarcocele, are readily eliminated, since in them the cord can, in the early stages, be felt perfectly free. A varicocele can also be similarly recognised from an omental hernia by the condition of the cord in its upper region; moreover, if the patient is made to assume the recumbent posture, the swelling disappears in each instance, but if a finger is placed firmly over the inguinal canal so as to prevent any protrusion of omentum, and he is then directed to stand up, the swelling immediately reappears if it is venous in character. To the practised finger, the diagnosis is never a matter of difficulty, since the enlarged veins of a varicocele and omentum are not at all alike to the touch, the veins moving freely under the finger 'like worms in a bag.' When a hernia is associated with a hydrocele or sarcocele, a little more care is necessary in order to distinguish between the two swellings.

The **Treatment** of inguinal hernia is either palliative by means of trusses, or radical.

Palliative Treatment.—Many different *trusses* have been introduced in order to prevent the descent of a hernia. No one form is capable of dealing with every case, and hence the truss must be selected with care, so as to suit the special needs of the particular patient. It is impossible to describe a tithe of the varieties which have been suggested, and hence we must refer our readers to special works on the subject. Suffice it to indicate the essentials of a good truss. It should consist of a pad kept in position over the hernial aperture by a steel spring (Fig. 399); it must fit the patient accurately, resting behind on the middle piece of the sacrum, and passing laterally mid-

t of the ilium and the top of the great trochanter. ıteral, the spring ends on the sound side just ıperior spine, and is prolonged anteriorly into ɔss-strap, which is secured to a stud on the pad. slipping up, an under-strap passes from the ehind the anterior superior spine along the fold ıner side of the thigh, being fixed finally to a ıd. The pad may be rounded or oval in shape, of soft iron protected by cork, but polished n indiarubber cushion filled with air, water, or employed instead; it should be well covered strength of the spring must be so adjusted as



Truss. (Down s.)

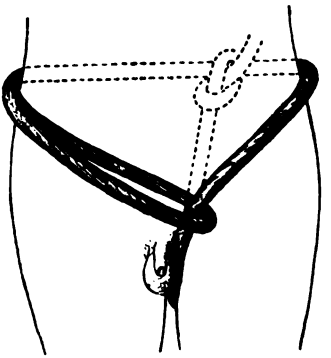


Fig. 400.—Wool Truss for Treatment of Hernia in Children.

nder all conditions of strain to which it may be ıt the use of undue force. In ordering a truss naker, the only measurement required is that ɔwing the line taken by the truss, and reaching ysis pubis; it is also advisable to mention the whether the opening in the abdominal parietes n the earlier cases of oblique hernia, the pad ver the inguinal canal than over the external ɔbject being to restore the valve-like action of mating its sides. In a direct hernia the pad tly over the opening. If such an apparatus is continuously worn, a cure is sometimes estab- a year or two, and in cases of congenital hernia ıay be confidently expected if the mother or d conscientiously carry out the necessary details. llowed to slip down, even after six or twelve l the previous good will have been undone.

cient support is afforded by a skein of wool fingering'), divided at one end, so that when

ı is so commonly associated in elderly people with
wards of the mesenteric attachment of the intestine
so that the hypogastrium obviously bulges; or (3) by
onal disease as precludes all unnecessary operative
4) Again, in cases of extensive irreducible hernia, the
masses of intestine which have lain for years in the
ncreases the intra-abdominal tension as frequently to
ırrence locally or elsewhere, and therefore operative
ough very desirable owing to the great risk of strangu-
by the patient, is often followed by very bad results,
ınt has previously been put through a course of semi-
persistent taxis in order to reduce gradually the size
ın.

st age at which to operate, statistics definitely prove
ially an operation of adolescence, the results gradually
ıs the age increases. Young children should not be
areful truss pressure for a year has failed, or unless it
› keep up the hernia by such treatment. In any case
viser to delay it until the age of three, owing to the risk
the wound from the constant saturation of the dressings

different operations have been described and practised
rgeons. One of the most satisfactory is that known as
:h has now been extensively employed, and has been
large measure of success. The instruments required
forcipressure forceps, dissecting forceps, retractors,
edle, curved hernia needles, and scissors. The opera-
escribed in the following stages: (1) The pubic region
›reviously shaved and thoroughly purified, an incision
:he direction of the inguinal canal and cord, about
length, its centre being a little above the external
g. This is carried through the skin and subcutaneous
the structures of the cord are reached, the superficial
: artery being necessarily divided *en route*; the pillars of
clearly defined, and the external oblique aponeurosis
›ut ¾ inch beyond the apex of the ring in the direction
(2) The sac has now to be identified; if the hernia is
nding, or contains adherent omentum or intestine, it is
sed; but if it is thin, empty, and of recent formation,
r in the case of a bubonocele, its identification may be
›me difficulty. The structures of the cord are lifted up
und, spread out over the fingers, the coverings divided,
› convex border of the fundus of the sac looked for. It
ly necessary to induce vomiting by titillation of the
er to cause the hernia to protrude, particularly when it
t type. (3) If the sac is empty, it is freed from its con-
the structures of the cord without opening it, and
r as or beyond the internal abdominal ring, as indicated
f fatty subperitoneal tissue surrounding the neck. If

4) The neck is then transfixed as high as possible, ith sterilized silk, and the sac cut off below the ap retracting well above the internal ring, and pre- rface towards the intestines, as we have been able a a post-mortem specimen, obtained from a patient nonary embolus ten days after operation. (5) The d are carefully examined, and any varicose spermatic s also any downgrowths of the subperitoneal fat and of the cremaster. (6) The opening in the abdominal d by a row of sutures passing through the arched rnal oblique and transversalis muscles, or through ndon on the inner side, and through Poupart's outer, the stitches being all placed *behind* the cord. e cord is drawn up out of the wound and held aside ig. 402, C), whilst the divided margins of the external sis are grasped by pressure forceps (A, A^1). Gentle ower pair enables the deepest portion of Poupart's lefined and seen. The stitches must secure a good ues, but should not include the external oblique when dealing with Poupart's ligament the proximity s must not be forgotten. Either interrupted or looped may be used, but if the latter, they must not be tied y may strangle the portions of tissue included in their necrosis. The opening in the abdominal parietes mmanded as far down as the pubic spine, but suffi- be left at the upper end for the passage of the cord, n of which would cause atrophy of the testis; some- ble to introduce a stitch above the cord, in order to t where recurrence is not uncommon. When the dful stitches have been introduced and tightened, ced, and the divided portions of the external oblique ther over it. (7) The wound in the skin is closed by ure, and usually no drainage-tube is needed.

nt.—The patient is placed in bed with the head low, lightly flexed over a pillow. The wound, as a rule, dressing for seven or eight days, when, on removal ; should be found completely healed, if asepsis has . The patient should turn to the opposite side in ter, and the greatest care must be taken to prevent ming soiled. Occasionally retention of urine follows ecessitating the use of a catheter. In the case of ll to seal the parts down after the first twenty-four lion dressing, and by preference the collodion should type, but with the guncotton replaced by celloidin).

t posture should be maintained for three weeks, and slightest work undertaken for at least six weeks, ffort until six months after the operation. Under es the use of a truss is unnecessary, and, indeed, we

ration. This consists in closing the canal by one or
ıtures, passed in such a way as to draw up Poupart's
ıe arched fibres of the internal oblique in front of the
the thread used for the fixation of the sac is drawn
ee end employed to close the external abdominal ring
ıxtent. The results of this proceeding are very good,
ıore difficult operation than Bassini's, and one loses
ı of opening the canal, and thereby exploring the
the cord. One is frequently finding subperitoneal
e canal, and these would inevitably be left, and would
to a recurrence of the hernia, if the canal had not been

ı *Operation* is much the same as Bassini's, except that
he internal oblique are also divided at the outer margin
ıl ring, and the cord displaced upwards and outwards
opening, so that at the spot at which it pierces the
rietes it may be surrounded by muscular fibres. The
closed as in Bassini's operation, whilst the external
o sutured behind the cord, which is thus made a sub-
ıcture. We see no special advantage to be gained by
from Nature's method of conducting the cord and its
ough the abdominal wall in an oblique direction.

after Operation is much less common than formerly,
go to prove that in experienced hands not more than
f the cases recur, and that rarely after the first twelve
already stated, it may be due partly to an injudicious
ases, partly to errors of technique, and in part to a
reatment, the patient being given too much liberty at
date. In connection with this we would especially
ı necessity for isolating the sac as far as possible, since
ı infundibuliform opening at the top of the closed
ıal is certain to persist. Another, and that perhaps
mon, cause of recurrence is septic contamination of the
e deep stitches are not involved, no great harm is done,
they have been removed or come away it is wise to
ıubsequently as a precautionary measure. Again, the
ion of a mass of intestine or omentum into the abdominal
uffice to raise the intra-abdominal pressure, and thus
a recurrence; hence the importance of removing as
tissue as possible in all bad cases. Relapses may also
tting or tearing of the tendinous structures around, either
passage of the needle, or by the traction induced by
e sutures; indeed, it is often the case that a hernia
ique may after operation be followed by one that is
obably from this cause.

it appears likely that recurrence may occur, a truss
lered. If, however, a hernia has developed, a second
ıuld be performed, if the condition of the abdominal
ınts it.

it tends to pass downwards into the scrotum, or in
ıe labium. Femoral hernia, on the other hand, usually
ably) occurs in women over twenty-five years of age;
ınal is free, whilst the neck is in the situation of the
elow and external to the pubic spine, and below Pou-
.t; moreover, it travels upwards and outwards, the
unaffected. (*b*) An *enlarged lymphatic gland* over the
ming may simulate this condition very closely; but
impulse on coughing
ıual hernial signs is
.cient to distinguish
wever, the hernia is
al and irreducible, the
slightly marked that
osis in a stout woman
cult without an ex-
:ision. (*c*) A small
canal somewhat re-
nia, but the limitation
r, its greater mobility,
nce of an impulse on
ıuld suffice to prevent
(*d*) A *psoas abscess*
he saphenous opening
ernia in the existence
e swelling with an expansile impulse on coughing. It
ed from it by the facts that there is no gurgle on
at the abscess, as it passes under Poupart's ligament,
ıter side of and behind the vessels; and that distinct
ccurs between the swelling in the saphenous opening
our, which can always be felt in the iliac fossa; the
signs of spinal caries are also usually present. (*e*) In
phena, if a pouch or so-called ampulla forms close to
nto the femoral vein, it may be mistaken for a femoral
ount of the marked impulse on coughing, and because
disappears on assuming the recumbent posture. It is,
ally associated with the signs of varix below, and by the
hough pressure is made over the upper part of the
after the vein has been emptied, the swelling regains
ize when the patient stands up.

FIG. 403.—FEMORAL HERNIA.

—When reducible and of small size, a femoral hernia
d by the use of a *truss*, similar in nature to that used for
ernia, except that the pad extends somewhat lower, so
a pressure along the course of the canal. A badly-fitting
mpress the femoral vein, and lead to œdema of the leg.
Treatment is undertaken either for the relief of strangu-
a radical cure is desired, as an *opération de complaisance*.
already made as regards the cure of inguinal hernia,
al principles there enunciated, apply also to this variety.

drill-holes, tying them below, the ligament is to the inner and upper aspect of the pubis. the canal by tissue which shall heal into it atricial barrier has also its advocates. Mr. cts up a portion of the pectineus muscle, and anal by means of sutures. He claims satisfac-

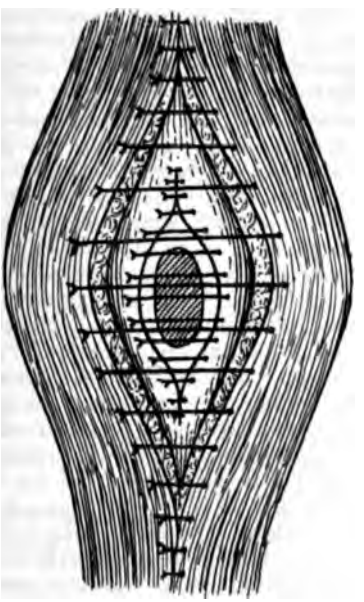
-Three different forms of umbilical hernia are

lical Hernia, or Exomphalos, is an exceedingly imperfect closure of the abdominal walls, as e intestine is not entirely withdrawn into the t is found in a cavity at the base of the umbilical ıs and enlarged. If the condition is overlooked, ı the ligature with which the cord is tied, and r at the best a fæcal fistula, will result. If left ord has separated, the peritoneal cavity will be peritonitis ensue. The only treatment is imme-luction of the gut, and closure of the umbilical

lernia of Infants and Young People, or, as it is arting of the navel,' is due to weakness of the hich yields before the intra-abdominal pressure. often determined by chronic constipation or ıg continual straining in order to evacuate the The condition rarely persists till adult life is lily amenable to treatment. This consists in regu-d the performance of circumcision, if necessary, lition is dealt with by strapping the abdominal s to tuck the umbilical cicatrix inwards; no pad istent cases it may be necessary to lay the sac uturing the parts together, as described in detail es the opening is often a transverse chink rather ınd it is sometimes advisable to introduce the lirection, thereby securing transverse apposition.

mbilical Hernia of Adults is usually due to a pro-ır intestine through an opening in the linea alba, bove or below the umbilicus, the former being It occurs most frequently in women who have ; sometimes due to actual rupture of the linea of the recti muscles. In such cases it is possible is also torn, and the intestines extravasated, as skin. A peritoneal sac is, however, usually ıding cases it is extremely attenuated, and so ding parts as to be unrecognisable, whilst the ted together in an almost inextricable confusion. ction is very liable to ensue, and if combined, as ith a subacute form of inflammation, it may even on. Moreover, the skin over the tumour becomes

t shall just cover the muscles comfortably. In fat ay involve the removal of considerable masses of fat. ı of this type is a severe one, and not to be lightly but if it is carefully conducted, the results in many successful. Of course, it is very desirable that the ıot put any strain on the abdominal wall for some time in bed for six weeks after the operation.



AMMATIC REPRESENTATION OF THE RADICAL CURE OF AN UM-WHERE THE RECTI MUSCLES ARE CONSIDERABLY DISPLACED.

nes represent the sutures which close the opening in the peri-ıg ones, the sutures needed for apposing the edges of the recti anterior walls of their sheaths.

ernia is the term used in describing any protrusion me spot in the anterior abdominal wall other than entioned. Several forms may be met with :

ımmonly consists of a protrusion of subserous fatty congenital or acquired opening in the linea alba, lineæ lineæ transversæ, especially at the junctions of the mer. They are more common above than below the f, as not unfrequently happens, the fatty tissue pro-ized tumour resembling a lipoma is produced, which ıe of a 'fatty hernia of the linea alba.' A portion of rawn through the opening into the centre of these ıey have persisted for some little time, and a true

origin, arising from imperfect development of one or
the diaphragm, and is most common on the left side.
er, result from traumatic lesions, such as stabs, involving
. The transverse colon or stomach generally protrudes
, and there is usually no peritoneal sac. *Treatment* is
in the majority of instances, although one or two cases
ernia have been successfully operated on through the
pleural cavity, thus permitting the closure of the hole
gm.

ernia consists in a protrusion of intestine through the
he thyroid foramen, and has usually been observed in
s. It is not often recognised in the living, except when
nd even then, unless of considerable size, it is likely
ed. It has, however, been diagnosed by the fact that,
the general signs of strangulation, there was a sense
ance and of fulness close to the origin of the adductor
ilst pain was referred down the obturator nerve to the
the knee. Rectal or vaginal examination may throw
the nature of the case. *Treatment* has generally been
ases of strangulation, and in these an incision is made
r aspect of Scarpa's triangle, and the pectineus divided
The sac when found should be opened, and strangula-
by cutting upwards, the obturator vessels being usually
w the neck of the sac.

ns of hernia, *e.g.*, **pudic, pudendal, vaginal, sciatic,** etc.,
scribed, but are so uncommon that they need no special

Abnormal Conditions of Herniæ.

lty of a Hernia is generally due to the presence of
ther between the contents and the sac, or between the
nselves, which are thus united into a mass too large to
the aperture of communication with the abdomen. This
ciated with contraction of the neck of the sac, which
from the pressure of an ill-fitting truss or the constant
contents. Overgrowth or an excessive deposit of fat in
a may result in irreducibility, whilst cysts may occa-
, as already described.

signs of this condition are very evident, whilst dyspepsia,
, and a sense of dragging are among the most prominent

—1. It may sometimes be remedied by *forcible taxis*
ervals, between which the patient is kept in bed, and an
d so as to contract the parts; moreover, the patient, if
e carefully dieted. It is most important not to operate
iæ of this nature until some such preliminary treatment
dertaken; the sudden reduction of a large amount of
the abdominal cavity has been responsible for several
interference with the heart's action. 2. Another plan

Strangulated Hernia.

s said to be strangulated when the contents are con-
:h a way as to obstruct and ultimately arrest the flow of
essels contained therein. Interference with the passage
ot an essential in this condition, since omentum alone
'ed, or the intestine, if present, may only have a portion
onstricted, as in the
as **Richter's hernia,**
's **hernia** a diverti-
arly affected.
varieties of strangu-
:ribed: those occur-
ne abdomen, which
ith more fully in
XVI., and those
ra-abdominal; it is
r to which we shall
:ention.
Strangulated Hernia
f two ways: (*a*) The
es strangulated im-
r its formation; this
ntly seen in children
s, the hernia being
congenital type, and
narrow sac. (*b*) In
e frequently results
on of an additional
abdominal contents
is the result of some
it effort. This con-
obtains in old-stand-
he neck of the sac
ously become thick-
tracted, either by the
truss or the irrita-
otruded viscera. The former of these two conditions
te in character, the latter more often subacute.

FIG. 406.—STRANGULATED INGUINAL HERNIA.

the constriction is either at the neck of the sac, or in
ues external to it (Fig. 406), but occasionally it exists
ost frequently the active agent in the strangulation is
sac wall itself; but in femoral and umbilical herniæ
side the sac, such as Gimbernat's ligament or the linea
the actual cause of the constriction, whilst it may also
y the passage of a coil of intestine under a tight adhe-
h a slit or aperture in the omentum contained in the
e herniæ which become strangulated immediately after

se to a catarrhal enteritis, and even occasionally to ster-
which may perforate and cause general peritonitis; this,
not very common in external strangulation, since the
ne is usually involved, and solid fæces are absent. In
: cases gangrene of the gut may be induced by the pres-
ccumulated contents and the action of the *B. coli*. The
ıe bowel *below the constriction* may be affected in a similar
ıg to the arrest of the peristalsis, but to a slighter degree.
vhen strangled, is at first congested and of a dark red or
ɔur, and later on infiltrated and matted together. If,
as contracted adhesions to the sac, and no gut is present,
ıay subside, since its vitality may be maintained through
s, and a natural cure of the hernia may result. Where
ion is not present, gangrene supervenes, and the omentum
s ashy gray or brown in colour, and is pultaceous and
loes not become offensive unless associated with intes-
does not contain any intrinsic source of putrefaction.
usually distended with fluid, which at the commence-
ıs in character, and perhaps blood-stained, whilst subse-
:comes turbid and mixed with lymph; finally, it is dark
ellowish green, with a marked and most objectionable
casionally there is but little or no effusion of fluid, a con-
lly due to complete strangulation of arteries and veins
ısly, and often the precursor of early gangrene. The
g of the sac is but slightly affected in the early stages; as,
e case progresses to inflammation or death of the contents,
mes inflamed, and ultimately gangrenous from the activity
, which by this time have penetrated to the turbid serum
within it. The skin and surrounding tissues become
, congested, and crepitant, and, finally, a natural cure may
ıed by sloughing and the establishment of an artificial anus.
ı relief of strangulation, even if no gangrene has occurred,
is not free from risk, owing to changes which may possibly
emporary arrest of the circulation. It has been shown by
gature around the ear of a rabbit that the amount of re-
ɜn the constriction is relieved, varies directly with the
ıith which the ligature has been applied, and with the
onstriction. When applied loosely and only for a short
storation of circulation is followed merely by a transient
, but as the completeness and duration of the obstruction
ɔd, the inflammation becomes more and more intense, and
ɜene may ensue. Similar results follow the relief of
l hernia. In the less severe cases the intestine merely
nporarily congested, but in the more acute forms the para-
gut may persist, whilst inflammation, possibly running on
:, may be produced, either in the strangulated portion or
ıediately above, or in both, and thus, although the opera-
ɜn skilfully performed, the patient may succumb.

cal History of a case of strangulation is usually so char-

ery severe. It is usually of the femoral variety, and the
st frequently involved. If less than half the circum-
e bowel is constricted, the obstruction is not always com-
t, flatus and fæces being sometimes passed; but where
alf the circumference of the bowel is engaged, complete
rom kinking or paralysis of the gut ensues. The vomit-
marked than in other cases, and is not so commonly
he tumour produced is small in size, but tense and tender.
is in these cases is always grave, partly from the diffi-
nced in diagnosis, partly from the tightness of the con-
ath usually results from perforative peritonitis, which is
due to wounding of the gut by the hernia knife. The
these cases is calculated at 62 per cent., which is in
rast with that of about 35 per cent., which is usually said
cteristic of strangulated hernia. Our mortality for all
angulated hernia admitted to King's College Hospital
ears 1892 to 1897 only amounted to 16·6 per cent.
rence of *strangulation in a pure epiplocele* is very rare; the
e vague in character, and the diagnosis is often difficult.
e of a soft, doughy, tender swelling in any of the hernial
bined with pain, bilious vomiting, and possibly constipa-
ys a significant feature. So long as no kinking of the
ised thereby, the symptoms may remain indefinite, the
er becoming fæcal; but as time goes on, arrest of peri-
ead to true obstruction, or even general peritonitis. As
tioned, strangulated omentum does not *per se* become
it occasionally a neighbouring coil of intestine may be
d, and its circulation disturbed sufficiently to enable the
cape, and then it may find its way into the sac, and
in its characteristic odour without any serious lesion of
or peritoneum being conjoined.
ment of a strangulated hernia consists in reducing the
axis, or by operation.
e term employed for the manipulation by means of which
duced. In cases of strangulation, it must be used with
d great care, since the involved portion of intestine is
d easily torn. The patient is laid on a couch with the
ted, and the thighs slightly flexed, so as to relax the
uscles. The fundus of the tumour is then grasped with
d steady pressure employed, having for its object the
the congested bloodvessels, and consequently a diminu-
e of the hernia; the fingers of the other hand manipulate
he sac, in order that the part which has most recently
ed may be first returned. The direction in which taxis
es in different cases. In inguinal hernia, it should be
ards, outwards and backwards. In a femoral hernia
xtended beyond the saphenous opening, taxis is first
nwards and inwards in order to make the gut re-enter
al, and then finally backwards and upwards, the margins

of the saphenous opening being relaxed by flexing and slightly inverting the thigh. In umbilical hernia, the pressure is mainly directed backwards.

Whilst admitting that taxis has a place in the treatment of strangulated hernia, we feel that that place should be carefully defined and limited. In the past it has been used injudiciously, and in cases where it could not be expected to do any good; the bowel has sometimes been ruptured or its wall bruised, the mesentery torn, and other serious results have followed. At the present day operative treatment for hernia is eminently successful, and open exploration of the sac enables one to judge of the condition of the gut and prevents the likelihood of returning to the abdomen an infected and even gangrenous focus. Hence we would conclude that *taxis is permissible* when the hernia is of large size, particularly when inguinal, when the symptoms have a mild onset and do not become severe, and especially if taxis has been successful on former occasions. *Taxis is objectionable*, and if employed at all should be used in the most perfunctory fashion, when the hernia is small and very tense, and particularly if femoral; when the onset is acute and sudden; when the symptoms are well marked, and especially if they become so in the early stages of the case; if strangulation follows on the first development of the hernia; and of course if the case has lasted for some time and fæcal vomiting is present. A final attempt may always be made before operation when the patient is anæsthetized.

In some of the slighter conditions of strangulation, and especially if the patient has had similar attacks before which have been relieved without operation, reposition may be assisted by applying fomentations for half an hour, followed by the use of an icebag, reduction sometimes taking place spontaneously or being brought about by taxis. The heat relaxes the tissues around the neck of the sac, and the effect of the cold is not only to constrict these tissues, but also to induce contraction of the intestinal bloodvessels and muscles.

Persistence of Symptoms after Apparently Successful Taxis.—It happens occasionally that although the surgeon may have apparently reduced the hernia satisfactorily, the symptoms of strangulation, viz., pain, vomiting, and constipation, persist. Such may be due to a variety of conditions, and considerable judgment is needed in coming to a correct decision in any particular case. (i.) Infective gangrene may involve the released coil of gut and spread to the portion above it, causing death from peritonitis and toxæmia. (ii.) Ulceration and perforation may occur along the 'constriction groove.' (iii.) The rupture reduced may not be the one which has given rise to the symptoms, an internal hernia, or one in some other region, co-existing. (iv.) The strangulation may have been caused, not by the neck of the sac, but by a slit in the omentum contained in the sac. Reduction in such a case would not relieve the symptoms, the whole mass being returned into the abdomen. (v.) The hernial sac may have a diverticulum or pocket communicating with it at its upper end (intraparietal interstitial hernia), or it may be shaped like an hour-glass.

e to reduce the intestine from the lower portion of this
nia en bissac into the upper pocket, and then of course the
ersist. (vi.) Reduction *en bloc* or *en masse* ought never to
it can only occur when considerable, and therefore in-
rce has been employed. The sac and its contents are
uced from their superficial position to the deep aspect of
ıal parietes, the hernia then lying between the muscular
ı the subserous areolar tissue, and the constriction re-
The hernia gradually disappears, but without the charac-
gle. In such a case the sac sometimes gives way, the
d the portion of the neck which compresses it being
vards. When occurring in the inguinal region it is
by the persistence of symptoms, and by the fact that a
ed into the canal, which is unduly patent, detects a tense
elling at its upper end. It also occurs, but less commonly,
al region, and in either variety the hernia may slip down
t time after its apparent reduction.

ase where, after an apparently successful taxis, the
f strangulation are still present, a most careful investiga-
ed in order to ascertain, if possible, the cause. Thus, the
ıd frequency of the vomiting must be considered, since
ıe to the anæsthetic, but then loses its fæcal character, and
e. If the vomiting is associated with a certain amount of
and possibly with some blood-stained diarrhœa or the
nucus, the probability is that the coil of gut has been in
ed, but has subsequently become inflamed. Apart from
ions the affected region must be thoroughly explored with
o as to ascertain whether any tumour can be felt at the
eper end, as occurs in reduction *en masse*. Should this
ght upon the case, the other hernial apertures must each
examined, and finally an incision is made over the sup-
of strangulation, and an exhaustive search made for the
) help is thus obtained, the abdomen must be opened, and
ıal complication sought for. In the inguinal region, all that
s to prolong the first incision upwards and outwards; in
hernia, it is perhaps wiser to make a separate laparotomy
the middle line, so as to avoid the division of Poupart's
whilst in the umbilical variety, the requirements of the
ıet by simply increasing the size of the communication
e sac and the abdominal cavity.

rative Treatment of strangulated hernia should always be
at as early a date as possible, when once it is certain that
s constricted. Nothing can be gained by waiting, whilst
lay of an hour may make it doubtful whether the result
cessful or not. There is always sufficient time to permit
purification of the parts, whilst it may be desirable to
lower bowel by an enema, and if there is much vomiting
t the stomach. The administration of an anæsthetic needs
n the worst cases local anæsthesia must be depended on

ut recovery thought possible, it is gently replaced just
bdomen, after freely dividing the constriction, and a large
e is inserted down to it. There is no need to fix the
s already inflamed and paralyzed, and hence will not
position, especially if a small dose of opium is subse-
ministered. In this way, even if gangrene or perforation
ck is left for the escape of the contents, while a localized
nmation will shut off the general peritoneal cavity. A
may thus be formed, but it often closes spontaneously at

gut at the time of operation is evidently gangrenous, the
ent consists in (*a*) *total removal of the affected coil*, and of
below and above it, especially the latter, so as to be well
infected focus. The ends are united together in the
nd a considerable degree of success may be expected in
have not been left too long. The intestinal canal is at
l to functional utility, so that the fluid and offensive fæcal
pass onwards, whilst the absorption of toxins from the
grenous gut wall is stopped. (*b*) In only too many of
however, the general condition is almost hopelessly bad
y, and primary enterectomy, even in expert hands, takes
It is then necessary to open the bowel and make an
. It is essential that a free passage should be made
onstriction into the gut above, but if possible without
loosening adhesions at the neck of the sac, whereby peri-
on is prevented. The introduction of the finger up the
e followed by a free flow of fæces; but if not, then the
nay be dilated from inside the bowel by dressing-forceps
lrainage-tube introduced; or the constriction at the neck
fully divided from outside, and either a Paul's tube or a
age-tube inserted. Of course, one should cut away as much
king gut as practicable. An artificial anus is thus formed,
hich for a time the patient can discharge the intestinal
nd unless this desideratum is at once attained, failure is very
llow the operation. The wound is left open and a suitable
pplied, into which the fæces can be received; possibly the
ation is a layer of protective with a sufficient hole in the
low the fæces to pass, and then over it a thick layer of tenax.
tive value of the two methods cannot be fairly measured
s, since so many of the cases treated by the formation
cial anus are hopeless from the beginning. There can be
n that, with our present methods of intestinal suture, a
re of success may be expected from the adoption of primary
the majority of cases.

thus dealt with the hernial contents, it is always advisable
a radical cure in uncomplicated cases, so as to prevent any
of the condition. This is undertaken according to the
ready described, and the external wound subsequently
drained.

The **After-Treatment** in cases of strangulated hernia is of the greatest importance. The patient is placed in bed, and absolute quiet is maintained, no food being allowed for twenty-four hours, although a little ice may be sucked or hot water sipped in order to relieve thirst. If there is no pain, opium need not be administered, as it helps to maintain the paralyzed condition of the bowel; severe pain may, however, call for the hypodermic injection of a small dose of morphia. Liquid food can usually be taken at the end of twenty-four hours, and, if the patient's condition remains satisfactory, it is unnecessary to administer any purgative, the bowels often acting naturally; if they remain unrelieved for five or six days, a dose of castor oil should be given.

Various **Complications** may arise after the operation, needing special notice. (1) *Vomiting* may persist for a time as a result of the anæsthetic. It loses, however, its fæculent character, and may generally be stopped by washing out the stomach or by the hypodermic injection of morphia. (2) The *Paralytic* condition of the gut may remain for some considerable time, causing prolonged constipation. If there is no evidence of inflammatory mischief, it is best treated by the administration of a purgative or by a turpentine enema. (3) *Acute Enteritis* may arise either in the portion of strangulated gut or just above. This is usually indicated by localized pain, and perhaps the passage of mucus, which may be so abundant as to amount to diarrhœa; the vomiting, moreover, persists, but is no longer stercoraceous. It is best treated by the administration of bismuth combined with morphia, whilst all solid food is interdicted. (4) It is possible that although the gut looked healthy at the time of operation, its walls were in reality already infected, and in spite of the relief of the constriction, *infective gangrene* may follow, causing death from peritonitis. (5) Occasionally acute septic peritonitis results from a localized perforation, either of a small gangrenous patch or from ulceration along the 'constriction groove.' *Treatment.*—The condition is obviously one of the gravest import, and must be dealt with actively if the patient is to be saved. The abdomen must be opened, the affected coil identified, and if need be resected, or fixed in the wound and opened for drainage purposes. The peritoneal cavity itself is dealt with according to the rules already given. (6) *Localized Peritonitis* may be looked on as a conservative measure, whereby Nature isolates some focus of danger from the general peritoneal cavity. Occasionally localized suppuration follows as the result of a limited ulceration or perforation of the gut; the pus must then be let out at the earliest possible moment, but a fæcal fistula is very likely to follow.

It is impossible to describe in detail every form of strangulated hernia. A few facts, however, must be stated about the more important varieties. In **Strangulated Inguinal Hernia** the constriction most commonly occurs at the neck of the sac, usually close to the external abdominal ring, as a result of the condensation of the surrounding tissues. The signs are usually very characteristic, and

Sequelæ of Strangulated Hernia.—(1) **Artificial Anus** may arise from the sloughing of the intestine and overlying skin apart from operation; or from the surgeon's interference, either by his opening the gut in mistake for the sac, or by his incising it when gangrenous; or it may slough subsequently, if left *in situ* when gangrene is threatening. After a time the surrounding parts settle down and heal over, the diversion of the fæces from their natural course becoming more and more complete, owing to the formation of what is known as a *spur* of mucous membrane, which lies across and blocks the entrance to the lower portion of the bowel. This spur arises partly as a result of the kinking of the gut, partly from the intra-abdominal pressure, which pushes the exposed inner wall of the intestine forwards. The effects produced by an artificial anus on the individual vary with the portion of the bowel involved. If the jejunum or upper part of the ileum is thus opened, the patient soon loses ground and becomes emaciated, owing to the escape of the intestinal contents before the nutritive elements of the food have been absorbed. Eczema of the skin in the neighbourhood is usually produced, resulting from the irritation of the fæces. For treatment, see p. 1025.

(2) **Fæcal Fistula** occasionally results from a strangulated hernia, owing to a perforative inflammation of the gut after the relief of strangulation, whether at the site of constriction or above or below it, in the latter case arising from a stercoral ulcer. Though the lesion may be intra-peritoneal, it by no means follows that general peritonitis need result, since sufficient plastic material may be formed around it to shut off the general peritoneal cavity, and to allow the extravasated contents of the bowel to find their way outwards through a sinuous tract to the external wound. It may be some days before any evidence of the existence of this condition appears. Not uncommonly the opening will close naturally as a result of cicatricial contraction, and hence no steps need be taken to deal with it until all hopes of such a result have faded. Where, however, it persists, attempts may be made to effect this purpose by injecting stimulating lotions, or by applying the actual cautery to the interior of the fistula; but more frequently an operation to expose, if practicable, the wound in the gut, and to close it by suture, or to remove the affected segment, will be necessary.

(3) **Stenosis** of the gut at the site of strangulation may ensue, giving rise to the symptoms already indicated (p. 1014), which may appear weeks or months later.

CHAPTER XXXVI.

INTESTINAL OBSTRUCTION.

l Obstruction,* or **Ileus**, is meant a condition in which passage of fæces is prevented. It is often associated r phenomena due to strangulation or kinking of the gut, in a deficient supply of arterial blood reaching the part, isposing to gangrene.

lements enter into the picture provided by a classical uction, and of these the most marked are:

asis, or retention of fæces. The fact that simple con- y last for a week or more at a time and do no harm to eyond a certain slight degree of toxic poisoning demon- his is not the only element in cases of obstruction, and :n an almost insignificant factor in acute cases. Yet it /hole picture, and has very marked results in the clinical ıs. Retention of the intestinal contents is certain to be heir decomposition and liquefaction, and this causes the ıal to be filled with a quantity of fluid offensive material, bacterial activity, partly to the pouring out of a con- ıntity of secretion from the congested gut wall. If the is only partial, this liquefaction of the bowel contents e them to pass on, and the patient's attack of partial ı is followed by one of diarrhœa, whereby relief is obtained. ruction, however, is complete, the intestine above the block y filled with this decomposing material, from which toxins sorbed, the patient being thereby poisoned.

l result of this decomposition of the retained fæces is the nt of gas, which may be so marked as to lead to great distension or *meteorism*. Whilst present in almost every ertain degree, it is most marked when there is considerable ıt of the mesentery, and experiments on animals indicate iction of the nerves contained therein is the chief factor ıction.

h of the material incorporated in this chapter we beg to acknowledge lness to Sir Frederick Treves' classical text-book on the subject y Cassell and Co.), than which nothing better has appeared, and ve freely utilized.

2. **Increased peristalsis**, with the object of driving on the intestinal contents past the block, is often an important feature in the case, leading to severe pain of a colicky character. So violent may these efforts become that the bowel, weakened by distension and inflammation, is finally torn, and perforative peritonitis rapidly ends the case.

3. **Regurgitant vomiting** is always a prominent element. At first the gastric contents alone are ejected, but later the vomit becomes bilious, and even stercoraceous or fæcal. The origin of this phenomenon is still a little dubious. Some have considered it due to antiperistalsis; others maintain that the ordinary onward movements of the bowel are quite sufficient to explain it. The intestinal contents are urged forwards against the face of the obstruction, and, being unable to pass, an axial regurgitant stream is produced. It is a little difficult to see how this could occur when the lower end of the colon is the part affected. Whatever the mechanical explanation, there is no question as to the influence of the nervous system in its production, or as to its being chiefly reflex in character, which is evident from the fact that it occurs equally when omentum or bowel is strangled. Hence, it is easy to understand that it commences early in children and sensitive women, on account of the greater irritability of their nervous centres, whilst it is also more marked when the small intestine is involved. Anything that increases peristalsis naturally intensifies its occurrence.

4. **Nervous phenomena** also add their peculiar features to the picture. The affected coil of bowel is directly paralyzed by the lesion, but, in addition, various reflex manifestations occur. Thus, in acute cases the patient suffers almost at once from shock, which passes off after a time, and from paralysis of the gut above and below the site of obstruction; vomiting and perhaps hiccough develop reflexly, and the latter sign is always to be looked on with grave suspicion and as an omen of grave import.

5. **Infective phenomena** are likely to follow sooner or later, the bowel walls being attacked by the virulent organisms contained within them. Complete paralysis and want of blood-supply predispose them to bacterial invasion, and hence the more acute forms of infective gangrene are chiefly seen in conditions of the strangulation type; when mere obstruction is present without vascular changes, microbic invasion rarely produces more than a patchy necrosis, or, more commonly, perforative ulceration. Of course, when infective gangrene is present, virulent toxins develop in the walls of the gut, and a rapid depreciation of the patient's general condition follows from their absorption.

6. Finally, **death** is almost certain to ensue apart from surgical assistance, although a few cases may recover spontaneously. The final event is due either to perforative peritonitis, or to simple exhaustion, the result of toxic absorption from the retained fæces or from the necrotic intestinal wall, of constant pain and vomiting, want of nutrition, and general dehydration of the tissues.

Causes. Much elaborate work has been undertaken to produce a

classification of the many diverse causes of intestinal
and when one mentions the fact that a recent attempt
ty distinct causative lesions, it is obvious that there is an
d for this type of ingenuity. It must suffice here to state
two great divisions—the dynamic and the mechanical.
ic ileus is due to some paralytic or spasmodic condition
nal wall, which results in interference with its power of
onwards its contents. *Paralysis* of the bowel results
ffuse or localized acute infective inflammation, as in
itis or acute appendicitis; (*b*) torsion of intra-abdominal
as the spleen or omentum, or of tumours, *e.g.*, ovarian
to the so-called 'aseptic' peritonitis; (*c*) embolus or
the mesenteric vessels, leading to necrosis; (*d*) nervous
may involve the spinal cord itself, or more frequently
l nerves, *e.g.*, a tumour at the root of the mesentery.
gut, as by chronic lead-poisoning, may also determine
henomena.

nical ileus is the variety most commonly seen. (*a*) The
strangled by bands or through apertures, causing internal
n. (*b*) It may be ***kinked*** over bands, thereby determining
clusion of the lumen, but also a marked interference with
r supply. (*c*) The gut may be *twisted* on its own axis,
to a condition known as volvulus. (*d*) One portion of the
be ***invaginated*** into a neighbouring portion, constituting an
tion. (*e*) The lumen of the bowel may be *blocked* by
lies or accumulations of fæces (obturation). (*f*) The
sage of the fæces may be rendered difficult or impossible
ecoming ***narrowed***, as from cicatricial or cancerous stenosis,
ure of external tumours.

t useful division is, however, the clinical, grouping together
which present a similarity in the symptoms; and this
l be employed here, the subject being discussed under
headings—acute obstruction, chronic obstruction, and
tion.

Acute Intestinal Obstruction.

wing are the chief **Causes** which give rise to this condition:
ulation by bands or adhesions, or through apertures, etc.
lus.
npaction of foreign bodies.
ulation over a band or acute kinking of the gut, both very
ions.
intussusception.
y be the termination of a chronic obstruction.
localized paralysis of the gut due to an infective inflam-
, acute suppurative appendicitis.
e noted that in the first five of these causes, where the
imary, there is a definite vascular lesion in addition to the
, which threatens the patient at an early date with per-

d, but at any time the lower bowel may empty itself, and opes as to the prognosis.

al Forms of Acute Obstruction must now be considered

ulation by Bands or Adhesions, through Apertures, etc.—*Isolated peritoneal bands and adhesions* are usually the result ic peritonitis of a localized and chronic character. The iety is met with in the appearance and situation of these most frequently they are single and metimes they are broad and membranous, constituting a false ligament; or, again, multiple. A common situation is ferent parts of the mesentery, or mesentery and some other viscus, eing either disease of that viscus pelvic organ, the cæcum, or the or inflammation of a mesenteric ocalized peritonitis. Two methods g strangulation exist; either the s under the arch or loop formed nstricting band, and cannot return r, if the band is long, it may form loose through which the bowel so becomes strangled (Fig. 408).

FIG. 408.—STRANGULATION BY BAND. (TILLMANNS.)

ed by the omentum result from union between its fimbriated nd some part of the viscera or parietes, forming at first a ke adhesion, which is gradually moulded into a rounded constant dragging and pulling to which it is subjected. ually coarser and thicker than those due to peritonitis. ism of strangulation is identical, the noose form being nore common, since the adhesions are likely to be longer. *iverticulum* (p. 1006) is liable to cause strangulation when ecomes adherent either to the parietes or to the viscera; d most frequently to the mesentery of the ileum, and the neighbourhood of the umbilicus. Occasionally the ends in a fibrous cord, which may remain fixed to the floats free in the abdominal cavity, and subsequently erent to some other structure, thus producing a fibrous gulation may be effected by bowel passing under the by the adherent diverticulum. (*d*) The *vermiform ndices epiploicæ*, or *Fallopian tubes* may contract abnormal and thus form arches or loops under which bowel may come strangled. (*e*) *Slits, pouches, and apertures* in the vestment, whether normal or abnormal, may lead to . All external herniæ may be grouped under this headose rare conditions known as internal hernia, in which l contents find their way into pouches in the posterior ritoneum, *e.g.*, into the lesser sac of the omentum, or fossa duodeno-jejunalis. Slits may also be found in the

omentum or mesentery, either congenital, traumatic, or the result of operations.

Phenomena.—This form of obstruction usually occurs in young people, and is rare after forty; it constitutes above one-fourth of all the forms of internal obstruction, and the lower 2 feet of the ileum are most frequently involved. There is commonly a previous history of peritonitis, but the onset is usually sudden, and the symptoms of strangulation, as detailed above, are of a typical character. The abdomen is flaccid at first, and not tender until peritonitis ensues, on about the third or fourth day. There is generally no obvious tumour, and no peristalsis or dilated coils of intestine are to be seen. Occasionally an area of localized fulness or fixed and limited tenderness may indicate the site of the lesion. The average duration is about five to seven days, the patients dying of exhaustion or toxæmia following peritonitis.

2. **Volvulus** is the most common cause of acute primary obstruction of the large intestine. By it is meant a rotation of the gut upon its own mesenteric axis in such a way as to interfere not only with the passage of the intestinal contents, but also, sooner or later, with the circulation, determining a condition of strangulation. Occasionally a similar result is brought about by the intertwining of one coil, usually of small intestine, with another. The sigmoid flexure is the part mainly affected, although it occurs in the cæcum or small intestine. In the former situation it is predisposed to by a long narrow sigmoid meso-colon, so that the two ends of the loop are brought closely together; this condition may be of congenital origin, but is usually due to the traction induced by prolonged chronic constipation; a distended sigmoid hanging into the pelvic cavity drags upon and elongates the meso-colon, tending to approximate the two ends of the loop, and necessarily causing a slight obstruction at these spots. Some irregular movement of the gut or of the abdominal walls suffices to cause rotation of the pedicle, and thus brings about the volvulus. When once present, plastic peritonitis soon fixes the coil, whilst the pressure on the vessels causes venous congestion and such obstruction to the arterial supply of the gut as almost certainly to end in its death. Distension of the coil with gas from decomposition of the retained fæces also aggravates the condition.

Symptoms.—Volvulus is rare before the age of forty, and apparently occurs more often in the male sex. A history of chronic constipation precedes it, but the acute symptoms start abruptly. Pain is always present, at first intermittent, but finally constant, and there is usually early tenderness over the sigmoid flexure. The pain, vomiting and collapse are not so severe or marked as in other forms of strangulation, but abdominal distension from excessive flatus, and resulting dyspnœa and thoracic embarrassment, are very distressing. Tenesmus is occasionally present. A localized peritonitis is usually developed, but sometimes it becomes diffuse. Natural cure is unknown, the patient dying either in five or six days from collapse and interference with respiration, or at a somewhat later date from peritonitis.

oreign Bodies, which may cause intestinal obstruc-
e types: gallstones, foreign bodies that have been
estinal concretions (enteroliths). The general facts
their presence in the intestine have been already

r cause obstruction when of large size, and then
rance to the intestine by ulceration from the gall-
duodenum. The usual site of impaction is in the
omen over fifty are most often the subjects of this
ere may be merely a history of some inflammatory
gion of the gall-bladder, and none of biliary colic.
quently suffer from intermittent subacute attacks of
uction, which, though severe for a time, are relieved
If the gallstone is not passed, a final acute attack
ch begins suddenly with pain and slight collapse,
iting, which is constant and copious, and in twenty-
x hours becomes fæcal. The obstruction is often
s and even fæces being occasionally passed. The
and flaccid, and the affected coil and the gallstone
felt. Necessarily the symptoms vary with the site
ually becoming more urgent as the duodenum is
eath results from peritonitis or exhaustion.
roliths are usually impacted near the cæcum, and if
struction the symptoms are similar to those produced
one, being preceded by chronic attacks and severe
n thin persons their presence may be detected by
abdomen.
ruction ensues when a coil of intestine lodges across
adhesion, the lumen at each end being thereby entirely
e circulation arrested. The usual acute symptoms
nay, however, be relieved spontaneously. Sudden
gut may lead to the same result, being due to the
brous adhesions or the dragging of diverticula.
Intussusception, see p. 1114.
e symptoms are developed at the termination of a
obstruction, the pain from being intermittent becomes
miting more violent and fæcal in character, and the
n is due to acute peritonitis, or to exhaustion and
lute constipation is always present, and the abdomen
ed.
uction is sometimes associated with acute localized
itonitis, such as is seen in appendicitis, when the
are paralyzed. This symptom is sometimes very
en fæcal vomiting may occur, but by careful atten-
ory and general condition of the patient a correct
d be reached. We append a table illustrating the
: points between acute strangulation and acute ap-
ated with peritonitis, one of the commonest causes of

	Acute Internal Strangulation.	Acute Appendicitis with Peritonitis.
Onset	Abrupt.	May be preceded by local pain.
Rigor	Absent.	Often present.
Temperature	Subnormal at first, rising at onset of peritonitis.	High at first, falling later from exhaustion or toxæmia.
Pain	Severe; referred to the umbilicus.	Severe; usually referred to the right iliac fossa.
Tenderness	Absent till peritonitis comes on.	Present over cæcum even in early stages, and gradually spreading.
Vomiting	Early, marked, and soon fæcal.	Less urgent, and seldom fæcal, except as a late symptom.
Abdominal parietes	Flaccid till peritonitis is present.	Tense and rigid from the first.

In most forms of dynamic ileus the obstructive phenomena are usually secondary to some peritonitic trouble, or to some intra-abdominal lesion which produces its own symptoms first, and then obstructive phenomena only as a secondary result of inflammatory paralysis. Thus in torsion of the pedicle of an ovarian cyst, the patient first complains of pain, and the tumour becomes large and tender. Should it be neglected, aseptic peritonitis ensues after a variable period, intestinal paralysis follows, and obstructive symptoms of a distressing type are produced, which will probably prove fatal, even if the cause is removed.

The diagnosis and method of examination of acute obstruction are dealt with at the end of the chapter (p. 1116).

The **Treatment** of acute obstruction is practically included in one word—**Laparotomy**. The condition of the gut is in most cases identical with that found in a strangulated hernia, and although a few patients may recover by palliative measures, *e.g.*, enemata, opium, ice, etc., yet the majority would be gravely injured in the delay caused by their employment. The danger of laparotomy increases directly with delay; hence, the sooner it is undertaken, the better for the patient. Whilst preparations for the operation are being made, an enema may be administered to clear the lower bowel, ice being given to suck, and a small dose of opium to relieve urgent pain. Two main objects must always be kept in mind in the operative treatment of such cases, viz., (*a*) to empty the distended bowel, and (*b*) to remove the cause of the obstruction. The second of these requisites is always most desirable, but unless at the same time the putrid contents of the upper portion of the intestine are removed, little real good has been accomplished, since the patient is being slowly poisoned by septic absorption. The late Mr. Greig Smith has declared most emphatically that 'no operation for intestinal obstruction is complete if the patient leaves the operating-table with a greatly distended abdomen.' Moreover, it must be remembered that the formation of an artificial anus is often insufficient to give

ng to the paralyzed and distended condition of the in-
ll above. Hence, in many cases it is desirable to deal
engorged bowel first, and to leave the search for the
ɜ body till a later date. A very high death-rate must
expected in these cases, but statistics prove that, in cases
cause of the obstruction is not at once obvious, primary
ıy, if followed by a satisfactory discharge of the intestinal
ɟives results in many instances equal to, or even better
ment directed towards the cause of the trouble.

ost urgent cases, where the patient's abdomen is acutely dis-
l fæcal vomiting has been present for some time, it is not
:o administer a general anæsthetic: if such is attempted,
's life is often lost from stoppage of the respiration, pre-
ɔssibly by a severe attack of fæcal vomiting. A few drops
may be placed under the skin, and a small incision made
: linea alba below the umbilicus; the first presenting coil
: is withdrawn, and after protecting the peritoneal cavity
or sponges is tapped with a large trocar and cannula so
the first gush of flatus and fæces to be carried away from
. The opening is then enlarged sufficiently to allow a
: to be introduced and tied in, and whilst the bowel is
tself, it is fixed by stitches to the abdominal wall. The
ould always be thoroughly washed out with warm water
ıring the operation.

ere cases, the stomach should be washed out as a preliminary
fore administering the anæsthetic. The head should not
n a lower level than the stomach, for fear of fluid regurgi-
; the œsophagus and choking the patient; several deaths
ıuse have been reported. The abdomen is then opened
lle line below the umbilicus, and a definite search made
ɛe of the obstruction if it is not at once obvious. The
passed to the hernial regions, and then to the right iliac
at the cæcum may be examined. If this is distended, the
ssarily lies below it; if collapsed, above it. In the former
ondition of the sigmoid flexure should next be investigated,
', if this viscus is collapsed, the hand should be run along
special attention being directed to the splenic flexure. If
ı is collapsed, perhaps the best method to adopt is to gently
from the abdomen successive portions of gut, about a foot
. These are carefully examined, and replaced by the
hilst the next portion is being withdrawn. The remainder
stines during this process are protected and kept back by
ıtion of hot sterilized abdominal cloths. The cause of the
ı is in this way sooner or later discovered, and may be dealt
ding to circumstances. If the intestines are too distended
such manipulation, it may be advisable to open or tap one
f the dilated coils, and thus reduce the distension before
with any methodical search for the obstruction.

l bands or peritoneal adhesions should be divided between

mpanitic, and its contour varies with the site of the
is is situated above the ileo-cæcal valve, the swelling
, whilst if in the rectum or lower portion of the
marked in the flanks. Distended coils of intestine
n through the abdominal walls in thin subjects, as
stalsis. When arising from simple stricture, no
felt; but if due to malignant disease, and if the
ery distended, the growth may possibly be detected.
on occurs in adult females who have previously
chronic constipation.
d sigmoid flexure are
ion seats of obstruc-
ansverse colon is not
ected (Fig. 409). A
nay often be felt at one
hich can in some cases
the fingers, whilst in
e of stony hardness.
e mass is usually more
ed, and the intestine
accompanying inflam-
temperature is often
ic absorption through
ll, and there may even
e acute symptoms are
by a prolonged period
ill-health, the appetite

FIG. 409.—DIAGRAM TO INDICATE THE USUAL SITES OF FÆCAL IMPACTION—VIZ., THE CÆCUM, TRANSVERSE COLON, AND SIGMOID.

the breath offensive, and the tongue foul. On
n the presence of scybala may often be detected.
mptoms arising from the other conditions which
nic obstruction, such as stenosis of the bowel, have
rred to (p. 1013).

of chronic obstruction is obvious, but it is often by
to ascertain the exact cause of the trouble. A
gation of the case, according to the plan given here-
ndertaken, and by this means some conclusion may
to the nature and seat of the obstruction.

t of chronic obstruction is always a matter of diffi-
y, owing to the uncertainty often felt as to the diag-
to be possible, however, to decide whether the block
large or small intestine, since the character of the
sion and the symptoms are tolerably distinctive in

ot of the most urgent type, the patient is put to bed,
d to fluids, and belladonna, combined with small
, administered. At the same time copious enemata
two or three times daily, and preferably in the genu-
, or lying on the right side with the pelvis well
es are studiously avoided, as also opium; probably

ayer (iii.), and between the two the *returning* layer
es the intestine enter, but with it a certain portion
; and it is to the constriction of the vessels con-
d later on possibly to their complete obstruction,
ous phenomena are due, *e.g.*, gangrene, perforation,
gut. In
ctual ob-
assage of
tents may
it by the
esentery,
orifice of
n slit-like,
and con-
intestinal
by the
portion of
within the
. Perito-
ws, being
invasion
damaged
the *B. coli*
al organ-
in extent,
d to irre-
intussus-
adhesions
the serous
ering and

FIG. 410.—INTUSSUSCEPTION. (FROM SPECIMEN IN COLLEGE OF SURGEONS' MUSEUM.)

In other cases, and especially when ulceration or
nt, a diffuse peritonitis may be lighted up, and this
death of the patient. The bowel above the site of
mes dilated, and possibly stercoral ulcers may be
ly in the more chronic cases.

tussusception is generally stated to be irregular and
however induced, whether by the presence of irritat-
y the existence of polypoid tumours, malignant
bly worms; the presence of scybalous masses of
ad to its occurrence. In a few cases injury, *e.g.*,
men, or severe strains during jumping, have been
or its onset.

is met with in four chief **situations**: (1) The *ileo-*
ch the commonest, constituting 44 per cent. of all
In it the ileum is protruded into the colon, the apex
tum being formed by the ileo-cæcal valve. Owing
lity of the ileum, a considerable portion of gut may
ed, and a good many cases have been observed in
ally projected through the anus. (2) The *enteric*

e-shaped,' following the course of the intussusception
lly curved, owing to the traction of the mesentery. In
cal variety it extends from the right iliac fossa across
the pelvis to the left, the colon being dragged downwards.
be associated with an absence of resistance in the right
h feels empty, constituting what is known as the 'signe de
n other cases the tumour may be more limited, and dis-
eable.

al cure occasionally follows, resulting either from spon-
luction, or from sloughing of the intussusceptum, whilst
eal cavity is shut off by a circle of plastic lymph uniting
thing and entering layers of the gut. When the latter
, the subsequent condition is not very satisfactory, owing
ation of a fibrous stricture.

Intussusception occurs more frequently in adults than in
e onset being gradual and the course varying widely in
ases. The patient complains of intermittent attacks of
licky nature, which recur at intervals, the attacks becom-
equent and prolonged as the case progresses. Vomiting
t little marked during the intermissions. The bowels are
1 their action, and there is sometimes a blood-stained
scharge. The general condition is not at first much
it as the case progresses, emaciation and general asthenia
rene. On examination, the abdomen is found to be flaccid
m tenderness, although visible coils of intestine may be
1 some cases, and perhaps a tumour felt. The symptoms
hose of subacute enteritis and chronic obstruction than of
on, and the case may be brought to a fatal termination
n acute attack of obstruction or by peritonitis. It may,
st a long time before being recognised.

t.—In the most acute forms of the disease but little can
ving to the extreme prostration of the patient; but in the
and in the chronic cases much can be attempted to prevent
e.

intussusception the patient should be at once placed under
e of opium, in order to still peristalsis and prevent the
the tumour. Inflation of the bowel with air, or the injec-
ious enemata of warm water or oil, may then be carefully
. No undue force should be employed in this proceeding,
placed over the tumour may enable the surgeon to detect
not it has been successful. It is performed by raising the
lvis and inserting into the rectum a catheter, with which
d an indiarubber tube and funnel, held about 1½ or 2 feet
bdomen. Should this not succeed, laparotomy should be
without delay, and the condition of the intussusception in-

An attempt is then made to reduce it by grasping the
one hand and gently trying to peel off the ensheathing
the upper portion of bowel, which is steadied by the other
about half the cases reduction is impracticable, owing to

ıg, the localized spot of fixed tenderness, and the quick
ɔn of the patient, all point to some vascular lesion of the
wall, which will prove fatal in a few days unless suitably
Ɔn the other hand, chronic cases are often preceded by
n and other troubles of defæcation; they come on gradually,
ıt first unaccompanied by constant pain and vomiting,
olic of a severe type may be present. The examination of
en is also of the greatest assistance; in acute cases intes-
lysis dominates the picture; in chronic cases, vigorous
can be felt and often seen, unless the patient has been left

fort must be made to determine the *site and nature* of the
to the question of site, the following points may be noted:*
n the *upper part of the small intestine* is involved, the vomit-
, tumultuous, and persistent; the vomit is bilious, but not
dominal distension involves the epigastrium, and particu-
omach. The lower part of the abdomen may be retracted.
early and rapidly increases. The thirst is terrible, the
retion slight or even suppressed; gas and fæces may pass
wer bowel.
n the *lower part of the small intestine or cæcum* is involved,
atus cannot pass; the vomiting becomes fæcal; meteorism
and involves the central part of the abdomen, the flanks
ffected. In chronic cases peristalsis is very evident.
ı the *colon* or *rectum* is the site of obstruction; the symp-
ore chronic as a rule, and even in acute cases, such as
ıe initial collapse is slight. Vomiting is later in appear-
ay, of course, become fæcal. Meteorism may be very
d involves the flanks as well as the centre; sometimes it
to recognise that the lesion is not lower than the splenic
distension of the left flank being absent.
ermination of the *nature* of the case will largely turn on the
revious history, and not uncommonly one has to admit that,
ɔne can locate the site of mischief, there is no clue as to its
ond the generalizations learnt from statistics.
tual examination of the patient is carried on along the
lines:
Previous History of the case should be carefully gone into,
o ascertain whether or not the patient has suffered from
ic, chronic constipation, acute diffuse or localized peritonitis,
rangements, syphilis or dysentery, etc.
History of the Present Attack should then be considered,
ecially the manner of onset, whether acute or gradual, the
f the symptoms, and whether or not preceding subacute
ve occurred from time to time.
more prominent **Symptoms** must then be considered.
ɒpse is due partly to reflex nervous disturbance, partly to
ɔtion of toxic materials, and partly to withdrawal of fluid

* See Tavel, *Revue de Chirurgie*, August, *etc.*, 1903.

it, as also the appearance of the face and the position
, should be observed.
ormal and abnormal hernial apertures are thoroughly
also the rectum and vagina.
omen is carefully palpated, so as to ascertain the
ıy tumour or increased resistance of the abdominal

may also throw some light on the case.
some information may be gained by the use of
a the obstruction is low down and not far from the
impossible to introduce more than a small quantity of
a spite of modifying the position. Too much reliance,
not be placed on this sign. It is also desirable to
colon during the administration of a large enema;
possible to hear gurgling sounds as far round as the
ing that the large intestine is free from obstruction.
attention here to the fallacy of using a long tube in
ı of being able to pass it into the sigmoid flexure. A
if the rectum and its valves will show the difficulty
the use of the genu-pectoral position renders it

CHAPTER XXXVII.

AFFECTIONS OF THE RECTUM AND ANUS.

THE rectum from the anatomical standpoint consists of the lowest 4 inches of the intestinal canal, but for the surgeon it represents the lower 6 or 8 inches which can be reached more or less from the anus. *Examination of the rectum* is carried out by the following methods :

1. **Digital Examination**, in which the index finger is inserted through the anus. Soap should be smeared under the nail and into the semilunar fold at its base, so

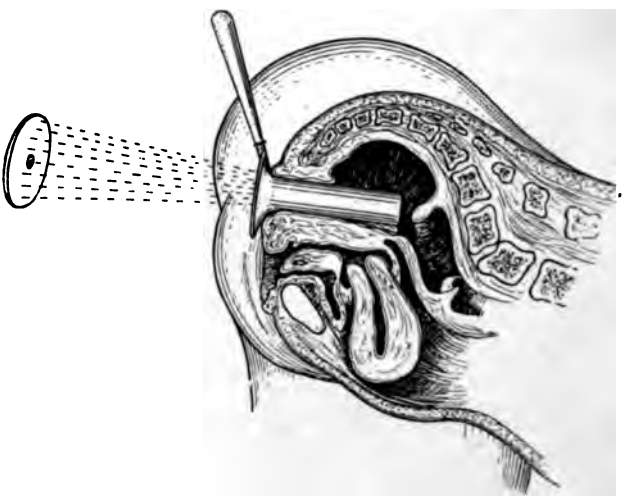


FIG. 412.—EXAMINATION OF THE RECTUM BY MARTIN'S PROCTOSCOPE.

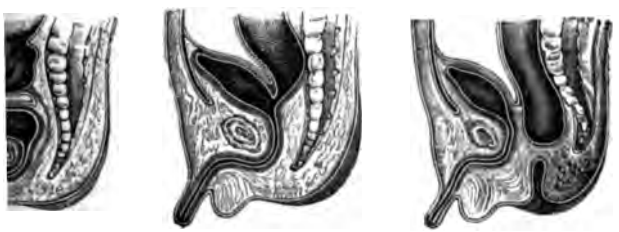
The patient is in the genu-pectoral position, so that when the proctoscope is introduced air rushes in and distends the rectum ; the observer, utilizing either an electric head-lamp or a laryngoscopic mirror, can easily see the interior. In the above diagram the projection of Houston's valves is clearly indicated.

as to prevent fæcal matter from lodging, and vaseline may be applied both to the finger and to the anus to facilitate introduction. It is, of course, advisable to have the bowel unloaded by purgative or enema before an examination is made. The patient lies on the left side in the gynæcological position, and the introduction of the finger is usually less painful if he strains down at the same time.

xamination can be conducted with the finger in the rectum, and the essed deeply over the patient's hypogastrium. Although the great ectal lesions occur within the lowest inch and a half of the bowel, must never omit to explore the upper part of the rectum, as an olypus or tumour may often be discovered in this way ; the pelvic id also be included in the scope of the investigation.

oduction of the whole hand has been recommended by some, but t be unusually small which can be thus utilized.

Examination is a most valuable proceeding. Martin's *proctoscope* he most suitable appliance to use for this purpose, but an ordinary speculum answers well. The patient is placed in the genu-pectoral ated lithotomy position ; the former is preferable, in that it allows l uterus to drop forwards away from the rectum. Two index greased and held back to back, are then introduced into the bowel, well stretched in several axes, so that its muscular tone is lost for a roctoscope can then be introduced, and it will be found that if the the correct position the rectum becomes ballooned by an inrush of erior can be clearly seen ; a head-lamp or a laryngoscopic mirror is ful in order to illuminate the interior. Houston's valves stand out



A B C

THREE VARIETIES OF MALFORMATION OF RECTUM. (TILLMANNS.)

el ends at the brim of the pelvis in a cul-de-sac, and there is no f an anus; in B the anus is also absent, but the bowel opens into r; in C the anus and bowel are only separated by a small space.

ten obstruct the view of the upper part, but they can usually be y a hook, or pushed aside by the speculum, or even if necessary vided. In this way 6 inches, if not more, of the bowel can be the eye of the surgeon, and topical applications can be made.

l Malformations — Imperforate Anus or Rectum.—The ion of the intestinal canal arises from the union of two risions. The upper, developed from the lowest portion of e hind-gut, is originally in communication with the bladder, a joint cavity or cloaca, the two, however, being early the posterior segment, which becomes the rectum, extends the pelvis, to be joined by an epiblastic pit or involution from the perineum, known as the ' proctodeum.' Failures evelopment may be due either (*a*) to the proctodeum being enosed; (*b*) to the rectum being absent (Fig. 413, A) or measure its cloacal condition and opening into some other , the bladder, urethra, vagina, or vulva (Fig. 413, B); ant of union between the upper and lower segments

malformations in connection with the post-anal gut have
ly described (p. 722).

of the rectum are usually due to falling on some pointed
as a stick or railing, or upon a piece of broken china.
ometimes due to the forcible introduction of foreign bodies
s or criminals. They may merely involve the mucous
or may penetrate the perineal tissues, enter the bowel,
rating the upper wall, lay open the peritoneal cavity.
ge, pain, and shock follow, and acute peritonitis if the
ibrane has been encroached on. Inflammatory troubles
ve the peri-rectal tissues, and sinuses may result from
1. A thorough examination must be made under an
and the wounds either sutured or left open to granulate.
the recto-vaginal septum may be torn, but the surgeon
no great hurry to interfere, since the opening usually
icatrization progresses; in some cases, however, where
s of some length, and the margins not bruised or inflamed,
suturing may be desirable. If the peritoneal cavity has
pen, a laparotomy is usually required in order to cleanse it
the wound; if, however, the wound is small and the rectum
e of injury empty, it may be justifiable to delay interference
sign of inflammatory reaction shows itself; a piece of
gauze packing in the rectal wound will often suffice to limit
matory mischief. Peri-rectal inflammatory complications
with as they arise.

Bodies are derived from various sources. Most frequently
been swallowed, and have traversed the intestinal canal.
s and small tooth-plates are most commonly seen, and
lly lodge just above the anus in one of the so-called
of Morgagni.' They give rise to severe pain, especially on
, and possibly to some form of peri-rectal abscess. Large
are sometimes lodged in the lower end of the rectum, just
sphincter, as well as a Murphy button when it has been
Foreign bodies may be introduced from without, and cause
rms of traumatic inflammatory lesions.

ation of the Rectum (*Proctitis*) causes pain of a bearing-
acter, a sensation of fulness, constantly recurring tenesmus,
ied by a discharge of mucus, muco-pus, or blood. It may
any local source of irritation, *e.g.*, the presence of foreign
of a polypus, parasites, or piles; gonorrhœa is an occa-
se—in women possibly owing to infection from the vaginal
in men probably from direct infection. In dysentery the
often involved as well as the colon, and extensive ulceration
resent. If the inflammation becomes chronic, a simple
ricture may result. *Treatment.* — Injections of lead and
of borax may be used locally, whilst the patient is kept in
nt position and on a low diet, the bowels being regularly
y the administration of laxatives or enemata. If much
s present, hazeline will often serve as a useful styptic.

hese latter, if having any influence, are merely the final gents.

nal Abscess forms immediately under the anal integument, ficial to the sphincter (Fig. 414, A.A.); it is usually due to tion of one of the numerous sebaceous follicles in that locality. acute or chronic, and is one of the most frequent causes of no. It must be freely opened throughout its whole length, d.

nally a sebaceous follicle becomes affected, constituting a may infect several others. If these can be dealt with early e may be limited, but if neglected a somewhat extensive ss may result.

bmucous Abscess (Fig. 414, S.M.A.) usually forms as the suppurating internal pile. The pus spreads up and down mucous membrane, and gives rise to a blind internal g. 416, 5). It is usually confined to one side of the bowel, s great pain on defæcation. Digital examination is exainful. Treatment consists in draining it at the most spot, close to the anus, but it may be necessary to slit up rmined mucous membrane in order to ensure healing. ble hæmorrhage may follow this proceeding, and it is not op except by firm pressure.

e Ischio-rectal Abscess is due to infection of the loose fatty ing the ischio-rectal fossa (Fig. 414, I.R.A.) with some organism, reaching it either through the perineum or from l. The *B. coli* is usually present, and in consequence the e ordinary characteristic offensive odour. A red, painful s noticed on one side of the anus, which is at first hard and ut soon becomes soft and fluctuating. Defæcation is expainful, as also digital exploration of the bowel, and the unable to sit with any comfort. If left to itself, it may rnally or externally, or in both directions, and a fistula-inry liable to follow. **Treatment.**—In the early stages the ld be well fomented, but when there is no doubt that pus is free opening should be made, the cavity washed out, and th some antiseptic dressing. If taken early enough, rapid may ensue without the bowel becoming involved, but when s membrane has been encroached upon or perforated, the ll not heal without division of the sphincter. A T-shaped incision is perhaps the best to employ in the early stages, d in Fig. 415; the cross limb of the T is parallel to the nates, and should extend through the whole of the inflamed ated tissues.

ic Ischio-rectal Abscess is usually met with in run-down lous individuals during young adult life, and is not unfrecomplication of phthisis. A deposit of tuberculous material he fat ordinarily occupying the ischio-rectal fossa, and this e undergoes caseation or forms an abscess, which gradually ithout pain or other inflammatory disturbance, until it

ay extend very widely and almost entirely surround the bowel. ter it has burst, the orifices of sinuses may be found at a con- lerable distance from the anus. The **Signs** and **Symptoms** are those a chronic tuberculous abscess. An indurated and painless mass ay be first felt in the fossa, and this slowly spreads, softens, and is nsformed into a more or less extensive abscess sac. The **Treat-nt** is as for all tuberculous deposits, viz., in the early stages, and possible before suppuration has occurred, incision, removal by a arp spoon of all tuberculous tissue, the application of pure carbolic id, and dressing the wound with gauze infiltrated with iodoform. here extensive sinuses or fistulæ exist, treatment as for fistula in-ano ist be adopted. At the same time, suitable hygienic treatment instituted, and the more so if physical examination of the

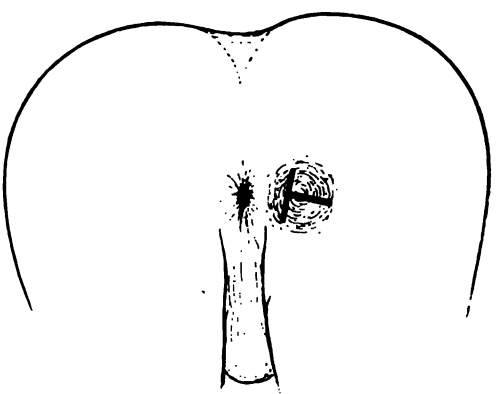
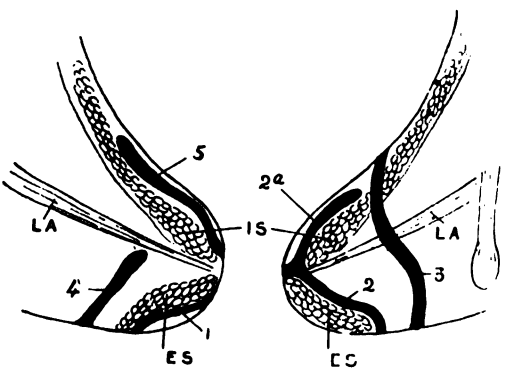


FIG. 415.—SITUATION OF T-SHAPED INCISION REQUIRED FOR THE OPENING OF AN ISCHIO-RECTAL ABSCESS.

gs or bacteriological examination of the sputum indicates the istence of pulmonary tuberculosis.

5. The **Pelvi-rectal Abscess** (Fig. 414, P.R.A.) consists in a alized collection of pus in the loose cellular tissue above the ator ani between it and the rectum. It may be secondary to tal lesions, such as penetration of the wall above the internal hincter or extension of ulceration from a carcinoma; but not commonly it originates from pelvic lesions, and may be caused by lvic cellulitis, or suppurative lesions in the meso-rectum, prostate. . The ordinary phenomena of deep suppuration are produced, d the pus may burrow downwards through the levator ani to the hio-rectal fossa, or may travel up and involve the pelvic peri- neum. Sometimes it extends laterally and may almost surround e bowel, causing one type of horse-shoe fistula. Other collections pus may find their way into this region from distant parts—*e.g.*, psoas abscess from spinal disease, appendix abscesses, etc. Rectal amination indicates the existence of a painful swelling high up in

As soon as a diagnosis is made, the abscess should be
pen and drained, and if possible by an incision behind
Of course an abscess which is secondary to a tuberculous
xception to this rule; in this every effort must be made
he necessity for an opening in this region, as infection is
llow.
onally a *diffuse* form of cellulitis involves the peri-rectal
issue, not uncommonly resulting in gangrene (*gangrenous*
It is most likely to be seen in weakly individuals and
nd the symptoms are very asthenic in type. The sup-
y extend above the levator ani, and lead to deep fistulous
e parts must be freely opened up, the gangrenous tissue
y, and the raw surfaces treated with peroxide of hydrogen.
are then stuffed with iodoform gauze, and subsequently



5.—DIAGRAMMATIC REPRESENTATION OF VARIOUS FORMS OF FISTULA-IN-ANO.

fistula resulting from an anal abscess; 2, a complete fistula, not the internal sphincter; 2a, secondary track burrowing under membrane; 3, complete fistula opening above the internal sphincter rsing the levator ani; 4, blind external fistula; 5, blind internal S, external sphincter; I S, internal sphincter; L A, levator ani.

d twice a day. Free stimulation is always required in , but the prognosis is very bad, death being probably cute toxæmia or pyæmia.

-Ano.—The term fistula-in-ano is somewhat loosely ll those conditions in which suppurating tracks are found bourhood of the anus and the lower end of the rectum. se are merely sinuses which have but one opening.

e of fistula is usually some suppurative condition, *e.g.*, an l or anal abscess, in the neighbourhood of the bowel; but nes the result of a stricture of the gut, the inner opening above, in the substance of, or below the cicatricial mass. e likely to be the case when multiple fistulæ exist.

—1. The *Complete Fistula* is one in which there are open-

ings both externally and into the bowel. When following an anal abscess, they are both close to the anus, and the track lies immediately beneath the skin and mucous membrane (Fig. 416, 1). When following an acute ischio-rectal abscess, the external opening is a variable distance from the anus, and the inner not more than 1 inch up the bowel, being situated in relation with the so-called internal sphincter (Fig. 416, 2); occasionally blind submucous or subcutaneous extensions are met with branching off from this (2^a), but not so frequently as when the fistula follows a chronic tuberculous abscess. In the latter case the skin may be extensively undermined, looking blue and congested, and the fistulous tracks may burrow widely, opening even on the thigh, or in the perineum or buttock. The so-called *horseshoe fistula* passes round the bowel, usually behind the anus, either superficial to the external sphincter or beneath it, and opens also on the other side. Moreover, the mucous membrane of the bowel is often undermined, and stripped from the muscular coat for some distance above the internal opening by sinuses or an abscess cavity. Occasionally the complete fistula which follows an ischio-rectal or pelvi-rectal abscess opens some way up the bowel as well as externally, and traverses the levator ani (Fig. 416, 3), constituting a much deeper and more serious lesion.

In any of these conditions secondary tracks may form, burrowing in all directions, and sometimes the opening up of these passages is a serious matter. Thus they may run forwards to the scrotum, or outwards into the gluteal region.

2. The *Blind External Fistula* (Fig. 416, 4) is the term applied to a sinus resulting from the opening of an ischio-rectal abscess in which no communication with the bowel can be discovered. A probe passed into the wound can often be felt by a finger in the rectum with only the thickness of the mucous membrane between. In dealing with these external fistulæ the possibility of the original cause being at a distance must not be overlooked.

3. The *Blind Internal Fistula* (Fig. 416, 5) is constituted by a sinus opening into the bowel just above the anus. Attention is usually drawn to the condition by the passage of pus with the motions or independently, and perhaps by preceding inflammatory disturbance. The orifice can sometimes be felt by digital exploration, and on the insertion of a speculum may perhaps be seen and carefully examined by a straight probe or one bent in the form of a hook; it is often associated with considerable undermining of the mucous membrane, and if chronic with stenosis of the bowel.

In all these conditions it is very difficult to obtain healing, owing to the introduction of septic material from the bowel, and to the state of unrest in which the parts are kept by the continuous movements, voluntary and involuntary, of the sphincters.

Operation.—The bowels must have been completely evacuated, both by means of castor oil or some suitable purgative, and about an hour previous to operation by enema, a most important preliminary, not only for the comfort of the operator, but also because it is very desirable that no further action should be required for some

e patient is placed in the lithotomy position, and the
nd anal regions shaved and purified. A probe is passed
istula into the rectum, and guided by it a grooved director,
:h a curved pointed bistoury is introduced, and the inter-
ıctures divided. In a superficial fistula, both sphincters
e division, and in a deep one both may be involved; in the
f cases, some fibres of the external sphincter are divided.
search is made for pockets or tributary branches of the
, and such, if found, are opened up and scraped out, under-
unhealthy skin being snipped away with scissors; bleed-
are, if necessary, tied, and the cavity carefully powdered
ırm, and lightly stuffed with oiled lint or gauze soaked in
nd glycerine. Pressure by a graduated compress of steri-
should be applied by means of a T-bandage.
sinus extends for some distance under the mucous mem-
the upper end of the original fistula, it may not be always
› lay it open to its whole extent, since such might involve
:morrhage at a spot where it cannot well be checked. It
. suffice partly to divide and scrape it, and then, if the main
ıs been satisfactorily dealt with, it will probably heal without
, especially if syringed out occasionally with stimulating

case of a horseshoe fistula, the sphincter need only be divided
pot, and that usually in the middle of the horseshoe. The
ıck must, however, be opened up, the cavity scraped, loose
ɪin removed by the scissors, and an ordinary dressing applied.
ll superficial fistula, not extending beyond the anal margin,
ɜtimes be entirely excised, and the wound closed by sutures,
ıecuring healing by primary union.

Treatment.—The bowels should, if possible, be prevented from
r four days, and most scrupulous care taken to keep the parts
The deep dressing need not be changed for the first twenty-
›rty-eight hours, provided that the surrounding skin is well
ith a warm carbolic solution. When the plugs are removed,
all strips of gauze soaked in iodoform and glycerine are
d night and morning after the wound has been syringed.
›urth day a good dose of castor oil should be given, and sub-
· care taken to secure an action of the bowels daily. The
allowed to granulate, and care taken that irregular healing
ead to a re-formation of the fistula. With this object in view,
advisable to pass a moderate-sized bougie from time to time.
l of a fortnight.

the incision is not carried very deeply, the patient's sphinc-
trol after operation is unimpaired: but if the internal
has to be divided, all control of the bowel is lost for some
ɜ cicatrization progresses, however, it is gradually restored.
healing is complete, control is usually perfect except when
ıt is suffering from diarrhœa.

ɜsence of tuberculous material locally and in the lungs must
.lly considered and taken into consideration in advising

operation. If the pulmonary trouble is early, there is no necessity for delaying operation; the patient will derive much more benefit from a stay in country air if his fistula has first been cured. In the later stages, however, it may be advisable to leave the fistula alone, or, at any rate, only to do such an operation as shall relieve any urgent symptoms.

Fissure of the Anus.—This is a most painful and troublesome complaint, met with most commonly in men, though not unfrequently in women of a neurotic temperament. It is occasionally due to injury or to the irritation of a polypus, but more often to the passage of large scybalous masses in patients suffering from chronic constipation. The fissure is usually single, extending through the posterior border of the anus toward the coccyx; a 'sentinel' external pile is often situated immediately over it, and the crack may lead to a definite ulcer just within the external sphincter. According to Ball of Dublin, it is due to one of the valve-like tags, left at the junction of the proctodeum and rectum, being caught by a scybalous mass, and torn from its upper connections. Each time a motion passes the sore place is reopened, and the valve pushed further on, until finally, having become swollen and œdematous, it appears at the orifice as the 'sentinel' pile, with an ulcerated surface behind or beside it. Sometimes several fissures are met with in the same individual, and then a syphilitic cause is probable, especially if they are placed at the side or front of the anus.

The **Symptoms** of this condition are very distressing, consisting of burning pain during defæcation, which often lasts for some hours. The pain is usually associated with tenesmus, and may radiate down the thighs or up the back, and not uncommonly to the left sacro-iliac joint; it may be so severe as to lead the patient to refrain from defæcation for prolonged periods. The fæces may be streaked with blood or pus, and there is a certain amount of discharge from the anus. On examining the part, the sphincter is found to be spasmodically contracted, and the entrance of a finger is forcibly resisted.

Treatment in the earlier stages is undertaken by regulating the action of the bowels by suitable laxatives, by the use of cocaine suppositories prior to defæcation, and by improving the general health. Sometimes the application of a hamamelis ointment, combined with the ung. hydrargyri nitratis dil., is most effective in giving relief. In confirmed cases the sphincter has been forcibly dilated by the thumbs, and the crack or ulcer cauterized; but by far the most efficient treatment consists in dividing its base with a straight probe-pointed bistoury, the incision at the same time including the external sphincter. The ulcer and the edges of the wound are snipped away with scissors, to facilitate the dressing and healing of the wound. The lower bowel should in all cases be carefully explored with the finger, especially with a view to the possible existence of a polypus, which, if undetected, would cause a recurrence of the mischief. Rest being thus obtained, healing soon follows. It is sometimes possible to close this small wound with sutures and obtain primary union.

...us Disease of the Rectum occurs in the form of ulcers, usually multiple, and may be very extensive. Infection ...s to the swallowing of infected sputum, but is probably ...of dissemination by the blood; the affection is usually ...to pulmonary disease. It starts in the submucosa, and ...which follow have the usual features, with undermined ...prominent granulations. There is usually a marked ...the production of fistulæ by extension of the process ... The symptoms are those of rectal irritability, pain on ... and discharge of muco-pus and perhaps blood. Treat-...ally palliative, the rectum being emptied by enemata or ...cording to the patient's comfort, and possibly healing ...troduced. In the worst cases, colostomy may be required ... put the bowel at rest.

... Disease of the Rectum and Anus.—The rectum and anus ...d by syphilitic disease in a variety of ways, the most ...eing as follows:

...nitial lesion or primary chancre is occasionally met with ...hbourhood of the anus.

...e secondary stage mucous tubercles or condylomata are ... seen, being placed either at the anal margin or sym-... on either side of the gluteal fold, the sores on one side ...dently infected the other. They are of the usual type ...nd are treated by dusting with powdered calomel, and ... piece of dressing between the lips of the fold.

...e tertiary period *diffuse syphilitic disease of the rectum* is not ..., occurring most usually, but not solely, in young married ... the poorer classes. It is a somewhat early tertiary mani-...nd usually commences within easy reach of the finger, ...ches from the anus. It starts as a diffuse gummatous ... of the rectal mucous membrane and submucous tissue, ...ome thickened and indurated, ulceration soon following. ...nomena are not limited to the rectum, but frequently ... the intestine towards the sigmoid flexure and down to the ... likewise involve the recto-vaginal septum and vagina, ...wn the latter canal to invade the perineum and neigh-...ructures, so that in a neglected case the whole external ...d anus may be involved in an irregular hypertrophic mass, ... resembling elephantiasis. In addition, the ulcerative pro-...extend more deeply, leading to the formation of fistulæ, ...tween the rectum and neighbouring viscera (*e.g.*, vagina ...), but also communicating with the exterior. From the ...n occurring in the submucous tissue, contraction of the ..., causing a *syphilitic stricture*, which may extend for some ... the bowel. The symptoms consist in pain, increased on ..., irritability of the bowel, and discharge of blood and pus ...s, whilst obstructive phenomena, or alternating attacks of ...n and diarrhœa, may also be present. On examination, ... ulceration and infiltration of the part are suggestive of

malignant disease, but the patient's age and history, and the course of the case, are usually sufficient to determine the diagnosis. The general health remains good in the earlier stages of the affection, but later on may be undermined by the pain and constant purulent discharge.

Treatment consists in administering mercury and iodide of potassium, the former perhaps in the shape of suppositories, whilst locally dilatation by bougies is necessary. In advanced cases colostomy is essential in order to secure rest to the parts, and give them a chance of healing. Possibly in a few instances only a temporary opening of the bowel may be required, but where much contraction exists and a considerable tendency to obstruction, the artificial opening must remain permanently. Sometimes the ulceration persists in spite of colostomy, and care must then be taken to prevent the retention of discharges by the occasional passage of bougies.

Fibrous Stricture of the Rectum is usually met with in advanced life, especially in women over forty years of age, and is most often situated 2 or 3 inches from the anus, or as high as its junction with the sigmoid flexure. In this position, it is usually due to the cicatrization and contraction of ulcers following prolonged diarrhœa and dysentery, although occasionally it follows tuberculous or syphilitic disease. Any form of chronic proctitis, *e.g.*, gonorrhœa, may also lead to it. It occurs sometimes as a sequela of pelvic cellulitis and suppuration, from the contraction of fibrous bands which may bind the rectum backwards to the sacral wall, or may merely constrict it: the stricture is in these cases usually at a lower point than in the former. Repeated attacks of inflamed piles may also lead to stenosis at or just above the anus. A stricture sometimes results from traumatism, or follows operations involving the whole or at any rate the greater portion of the circumference of the bowel. As already mentioned, it may be associated with a fistula, especially if the latter has existed for long; the inner opening may then be found in the substance of the stricture, as pointed out by the late Mr. Henry Smith.

The earliest **Symptoms** of stricture are often alternating attacks of diarrhœa and constipation, in which, of course, the constipation is primary, and the diarrhœa due to a catarrhal enteritis arising from the irritation of the retained fæces. Gradually the difficulty in passing motions becomes more and more marked until no relief is obtained apart from medicine; the fæces themselves become narrowed, flattened, and elongated, something like pipe-stems, or small masses like shrimps may alone succeed in passing. This is associated with pain and uneasiness referred to the lower bowel; a certain amount of blood and mucus may be mixed with the excreta, and sooner or later marked dyspepsia and abdominal distension supervene. If the case is allowed to run on without treatment, absolute obstruction of a chronic type may result, and lead to a fatal issue; or the mucous membrane of the bowel above the stricture becomes ulcerated, an abscess forms, and subsequently a fistula, through which a certain small amount of fæcal material passes. If several of these fistulæ

hed, the patient may finally succumb to chronic septic
id exhaustion.

nation of the bowel with the finger may reveal a smooth,
triction of the gut as if a band had been tied round it,
nass and the aperture in it feeling something like an os
:her cases, the bowel is stenosed for some distance, and
ıore or less ulcerated; whilst if due to pelvic cellulitis, it
rn up and fixed to the posterior pelvic wall. When the
too high for the finger to reach, the gut may appear
ugh somewhat dilated (ballooning). Sometimes the
smooth, and free from nodular irregularities and excres-
en, however, it is ulcerated and irregular, the examination
at pain. The gut above the contraction is hypertrophied
led, whilst if filled with retained fæces, the mucous mem-
show signs of inflammation, or even stercoral ulcers. The
he stricture is usually dilated (ballooned), partly from para-
walls, and partly by invagination of the mass from above.
atment in the early stages consists in keeping the bowels
l the motions soft by means of laxatives, such as castor oil
whilst the passage of the excreta is assisted by enemata.
s regulated, and the strength maintained, if need be, by
ocally, the stricture, if within reach, should be dilated by
ougies passed in increasing sizes every two or three days,
taken that the point of the instrument engages the stric-
s not caught against folds of mucous membrane or turned
. The utmost gentleness must be used, in order, as far as
stretch the mucous membrane, and not tear it. Laminaria
sed sponge-tents are of use in some cases, followed sub-
)y bougies. When situated low down, the stricture may
l posteriorly, or slightly nicked in several places with a
ted bistoury, and bougies then passed. There is always a
ncy in these strictures to contract again, and the patient
nstructed to pass a bougie for himself at short intervals.
:ture is out of reach, or signs of obstruction manifest
in spite of treatment, colostomy is the final resource.

of the Rectum.—Polypus Recti occurs most frequently in
ıd consists usually of an adenoma of Lieberkühn's follicles,
nally of simple fibrous tissue covered with mucous mem-
ey are commonly found within easy reach of the anus,
: an appearance something like a small cherry with a long
ndulous and freely mobile. The **Symptoms** caused are
)f the bowel and the passage of blood by the anus, which
occurring in a child without symptoms of obstruction is
ıognomonic of polypus. The tenesmus excited may lead,
ıd elsewhere, to prolapse or to the occurrence of an intus-
It is occasionally associated with a fissure of the anus,
ably arises as a secondary result of the irritation caused
al extrusion of the polypus during defæcation. A natural
effected by rupture of the attenuated pedicle, which is at

first attended by a certain amount of hæmorrhage. **Treatment.**—The polypus is cut away after tying or twisting its pedicle, or the clamp and cautery may be employed.

Papilloma of the rectum is a rare disease, and gives rise to hæmorrhage from and irritability of the bowel, or, if large, even to obstruction. This condition is not always limited to the rectum, but may extend through the greater portion of the intestine, and then proves fatal from hæmorrhage. **Treatment** consists in removal by ligature or wire snare, where practicable.

Sarcoma is another uncommon disease in the rectum. It occurs in the shape of a large fleshy tumour growing from the submucous tissue, and projecting into the lumen of the gut so as to cause obstruction. It is less painful than cancer, and usually occurs at an earlier age. The symptoms are much as in the latter disease, and the **treatment**, when feasible, is the same, viz., extirpation of the growth, but it will very probably recur.

Epithelioma of the Anus (*i.e.*, of the skin covering the anal margin) occurs as a primary development similar to that on the lip, and is then of the squamous type. It presents the usual features, viz., an indurated nodular mass, which readily ulcerates, and runs the typical course of such a disease, infecting the inguinal glands. It is readily dealt with in the earlier stages by an operation somewhat similar to that for excision of the rectum.

Cancer of the Rectum appears in the form of columnar carcinoma, consisting, as described elsewhere (p. 208), of an overgrowth of Lieberkühn's follicles, not only into the lumen of the gut (centrifugal or papillomatous type of growth), but also invading the deeper portions of the bowel wall, infiltrating the submucous and muscular layers (centripetal growth). A vascular fibro-cellular stroma is found between the glandular acini, and the physical characters of the tumour are largely dependent on the relative amount of these two elements. Thus, (*a*) if the stroma is abundant and fibro-cicatricial, the growth is comparatively slow; the tumour is hard and nodular; it usually starts on one side of the bowel as a malignant wart-like mass, but gradually encircles the gut, and is always likely to produce obstructive phenomena from its contraction; ulceration occurs after a while. (*b*) In the softer, more rapidly-growing type, the stroma is less abundant, and merely fibro-cellular in character. The tumour projects into the bowel, and early involves the whole circumference; ulceration and bleeding are constant features, and the pain is usually considerable. There is always greater destruction of tissue, so that obstruction to the onward passage of fæces is much less likely to occur in it than in the former type, where cicatricial contraction is a marked feature. The ulcer which develops in the bowel is of the usual malignant type, with an excavated surface and indurated everted edges (Fig. 417); it bleeds readily, and its investigation is very painful. Colloid degeneration is occasionally seen in cancer of the rectum.

As the disease progresses, it invades surrounding parts, and thus the tumour may become adherent either to the pelvic walls or to the

ina, or prostate; sometimes the iliac vessels or sciatic compressed, causing œdema or neuralgia respectively. : must be understood that this invasion is in part inflam- due to absorption of bacteria, etc., from the ulcerated this is always a grave addition to the case. Peri-rectal nd fistulæ sometimes form, opening externally in the fossæ, or perhaps internally into the bladder or vagina, e tumour begins to develop along the line of the fistula, tually form a mass of some size in the bladder.

ARCINOMA OF THE RECTUM. (KING'S COLLEGE HOSPITAL MUSEUM.)
, split open posteriorly; 2, 2, margins of the ulcerated growth.

nds in the meso-rectum and the lumbar glands become ut for a time this may be merely inflammatory in type; : is of a cancerous nature. Not unfrequently it leads ion of the meso-rectum, in consequence of which the rawn back towards the posterior pelvic wall, and more ed there—an important diagnostic sign in some cases. r, of course, leads to involvement of the inguinal glands. deposits may also be found in the liver, but this is not on, and may even be disseminated throughout the body, is decidedly rare.

The **Symptoms** of the disease are often so slight and the onset so insidious as to raise no suspicions of the existence of any growth until it has attained considerable size. The patient is usually an adult, and more often male than female. At first there may be merely some slight constipation, requiring an increased amount of opening medicine. Then may come more definite attacks of constipation, alternating with diarrhœa, and the discharge of large quantities of mucus, often blood-stained. A sense of weight or dragging pain is noticed in the rectum, and the patient after defæcation feels as if there is still something to be passed. This sensation increases until true tenesmus and straining at stool are present, together with constant pain, which may radiate up the back and down the legs, causing sitting on any hard substance to be painful. At first a blood-stained discharge may be seen on the fæces, which become flattened and pipe-like, if stenosis is present, but later it passes independently of the motions. On examination, an ulcerating, crateriform mass is met with, which may either be limited to one segment of the gut wall, and is then usually firm, and perhaps associated with stenosis, or it may surround the bowel, and feel soft and spongy, readily breaking down under the finger, and bleeding freely. The bowel below the growth is usually 'ballooned.' This examination is generally painful, as also the process of defæcation, and sometimes the patient abstains from the latter for lengthened periods on account of the exquisite agony caused thereby. When the anterior wall is involved, the bladder is often fixed to the mass, and micturition becomes painful; moreover, every time the bladder is emptied a discharge may occur from the bowel, and this may continue even after colostomy has been performed. Marked cachexia supervenes, the digestion becomes impaired, any meal causing pain and flatulent distension; natural sleep is impossible, and if a recto-vesical fistula forms, the patient's troubles are further aggravated by the passage of fæces and flatus by the urethra.

The case runs a more or less rapid course to the fatal issue, which on an average ensues about seventeen months after the onset of symptoms, if no operation has been undertaken (Jessop*), and may be due to a variety of causes. Fæcal obstruction occurs in about 30 per cent. of the cases, being more marked in the chronic forms, and in those where the disease starts high up the bowel, on account of the peristalsis causing invagination of the mass and occlusion of the tube; whilst if ulceration is excessive, or the disease situated low down, obstruction is much less common, invagination being here impossible, and peristalsis being expended on the onward passage of the fæces. Exhaustion from hæmorrhage, pain, sleeplessness, or septic absorption, accounts for most of the fatal results, whilst septic peritonitis following the perforation of stercoral ulcers above the growth occurs in a few instances.

The **Treatment** of cancer of the rectum consists in the radical measure of excision of the mass, or in the palliative operation of colostomy.

* *British Medical Journal*, 1889, ii., p. 407.

of the Rectum, or proctectomy, is only applicable to those
ich there is a reasonable prospect of the whole disease being
. This depends not on the upward extent of the growth,
question of fixation to surrounding parts. When the
t fixed anteriorly so as to endanger other viscera, *e.g.*, the
bladder, the case is a favourable one for excision. Fixa-
mass laterally or behind is not so important, although
vent removal, if extensive. Enlargement of glands in
ectum does not necessarily contra-indicate operation, as
be merely inflammatory and not invaded with malignant
d can be included in the scope of the high operation.
lumbar glands are involved, or the liver, a radical cure
n cannot be expected, and it is probably wiser not to
, even if the local signs are favourable. Formerly it was
d of vital importance to avoid opening the peritoneum; but
sent day this is frequently done, and with no untoward result,
ecautions are taken; so that, although the growth may be
igh up, if it is freely moveable, and there is no evidence of
deposits, an attempt should be made to take it away. It
remembered that in the male the peritoneum is reached on
or aspect of the gut about 2½ inches from the anus with an
ed bladder, whilst it *may* be pushed up another inch when
is is full; in the female the peritoneum is situated about
rom the anus, being reflected to the posterior aspect of the
ri. Posteriorly, the lower 4 or 5 inches of the bowel are un-
y serous membrane in both sexes.
od practice to anticipate the radical operation by a pre-
olostomy, unless the case is a very early one. Where the
umference of the bowel has to be removed for 3 inches or
d the operation involves the anus, the passage of fæces
he wound is not only a source of septic contamination, but
es extreme pain, whilst the condition subsequently left is
rtain to err on the side either of patulency or of contraction,
is total loss of control. An effective anus in the iliac
viates all these difficulties, whilst the preliminary operation
surgeon a chance of investigating the condition of the
sacral glands, and of ascertaining the extent of the growth
owel. If, however, the anal canal is free, it is possible to
e growth by the high operation, and to unite the upper seg-
he lower, thereby restoring the continuity of the intestinal
nder such circumstances colostomy may be omitted as a
y, or at any rate only undertaken as a temporary measure.
e union between the two segments fail and a sacral anus
olostomy can always be resorted to at a later date.
rms of operation are described, according to whether the
situated high up or low down. The latter, or low opera-
times known as Langenbeck's, is performed through the
; the former, for dealing with cancer situated higher up,

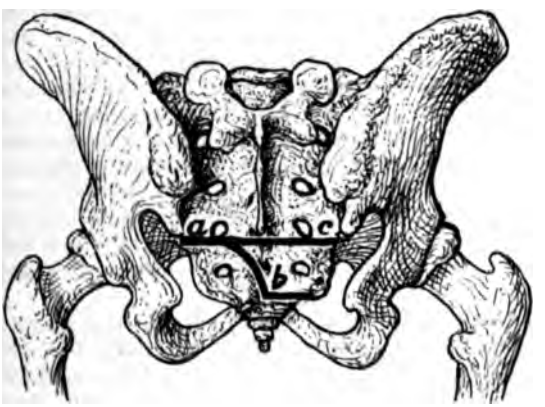
ecessitates partial removal of the sacrum or coccyx, and is known s Kraske's.

1. *Low Operation.*—The rectum having been thoroughly washed ut and emptied, and the patient placed in the lithotomy position, ie perineum is shaved and purified, and the posterior wall of the ectum and anus slit open in the middle line as far as the tip of the occyx. An incision is now made all round the anus at the junction f the skin and mucous membrane, if the anus is healthy; when iseased, the incision is extended beyond the margin so as to include ie growth. The rectum, together with the tumour, is then separated om surrounding structures by scissors and fingers, commencing osteriorly, where this is readily effected, dividing the levator ani n each side, and working gradually upwards and to the front, where reater care must be taken to protect the vagina, prostate or iembranous urethra. In the male, a bougie or catheter may be assed into the urethra with advantage. Bleeding points can be ecured during this process by pressure-forceps. The upper attach-ients of the gut are divided either by scissors, écraseur, or clamp nd cautery. Hæmorrhage, which is generally very free, is arrested y ligature or cautery, and the gaping wound powdered with iodo-orm, and plugged for twenty-four hours with gauze, the posterior icision not being closed by suture, and no attempt made to drag own the mucous membrane. Subsequently the wound may be left ithout any internal dressing, an external pad of salicylic wool ufficing; it is thoroughly washed out two or three times a day with ome dilute antiseptic, such as sanitas (1 in 10), Condy's solution, r carbolic acid lotion (1 in 60), which may be used alternately: ranulations gradually cover the surface, and, as cicatrization pro-resses, the mucous membrane is by degrees approximated to the kin margin, and the patulous cavity diminished in size until healing s complete.

If the growth affects one side of the gut alone, the operation is nodified by only removing that half. If fixed posteriorly, the occyx, and even a part of the sacrum, may be taken away without iesitation to facilitate the extirpation of the mass.

2. *Kraske's or the High Operation.*—The patient reclining on his ight side, an incision is made in the median line from just behind he anus to the middle of the sacrum, but without opening the owel. The coccyx is excised, and the great sacro-sciatic ligament nd gluteus maximus detached from the left side of the sacrum. Part of the left wing of the latter bone is now removed by chisel and hammer, the incision being curved, and extending from the median ine below, through or above the fourth posterior sacral foramen to the under border of the third, and then to the left border of the bone at that level (Fig. 418, *a b*). The loose cellular tissue behind the rectum is thus exposed, and the gut, together with the tumour and the enlarged glands in the hollow of the sacrum, is freed from its connections, and amputated from the sound gut above, the peri-toneum being usually encroached on in this stage of the proceedings.

sterile gauze is packed in to protect the cavity from
and the opening is subsequently sutured up. If the growth
the anus, the whole length of the rectum below is excised,
he upper segment is drawn down and sutured to the skin.
ncter and lower inch or two are free from disease, they
situ, and carefully sutured to the lower end of the upper
although it is very probable that union will not occur.
d is carefully washed out, and stuffed with gauze sprinkled
orm; even if the peritoneal sac has been opened, no harm
y come of it. The results which have followed this severe
ire, on the whole, encouraging.
modifications of Kraske's proceeding have been suggested,
best being that performed by Bardenheuer. The sacrum



—PELVIS SEEN FROM BEHIND TO INDICATE THE LINES OF SECTION OF THE SACRUM AND COCCYX IN KRASKE'S OPERATION.

Kraske's original operation; *a c*, Bardenheuer's modification.

l, sawn across just below the third foramina (Fig. 418, *a c*),
portion thus detached is totally removed. By this means
ore extensive view is obtained of the pelvic contents, and
of the operation increased.
n of the rectum is a proceeding only practicable in com-
few cases of the disease (Jessop states 15 to 20 per cent.),
results may follow from shock, hæmorrhage, or peritonitis.
low operation the tendency to recurrence is considerable,
lisease is not then so painful as before, since the nerve
have been removed. In the cases that are cured a certain
f inconvenience is certain to follow from either a patulous
sed condition of the anal orifice, and it is still a moot point
n many cases a simple colostomy is not as valuable as

dy stated, if the radical operation is not feasible, **Colostomy**
means whereby the patient's condition can be temporarily

ameliorated. The surgeon should not wait until urgent symptoms develop, but the operation may be justifiably undertaken at an early date for the following reasons: (*a*) It allows the patient to indulge in solid food, and thus assists in maintaining the general health; (*b*) it frees him from the pain arising from the passage of fæces over the ulcerated surface; (*c*) it may possibly retard the growth of the disease by eliminating the irritating action of the fæces; (*d*) it removes all chance of intestinal obstruction from the growth itself; and (*e*) it diminishes the absolute risk of the operation by doing it when the patient is comparatively well and hearty, and when there is no urgency. Formerly, when undertaken for obstruction alone, the death-rate was about 30 or 40 per cent.; in an early iliac operation it is now practically nil, or at most 3 or 4 per cent. On the other hand, the surgeon must not promise the patient too much as the result of a colostomy. (*a*) It may not relieve the pain at all, as this is not unfrequently due to the implication of nerves which are dragged upon by the growth. (*b*) The discharge of muco-pus and blood may continue unchecked, causing tenesmus and constant calls to empty the bowel below the artificial opening. This condition usually obtains in the soft ulcerative type, and the additional attention required by the colostomy wound may make the patient's life a burden to him. Colostomy gives its best results in the chronic type tending to stenosis; in the ulcerous soft form it must not be undertaken without due consideration. For details as to colostomy see p. 1019.

Should the patient refuse colostomy, or should it be for any reason contra-indicated, treatment consists in limiting the diet to such materials as strong broths, arrowroot, etc., with some stimulant, so as to give as little fæcal remains as possible, and to enable him to do without an action of the bowels for about a week at a time. The strength is husbanded by keeping him in bed, and pain is checked by the administration of morphia.

Hæmorrhoids, or Piles, consist in a varicose condition of the veins surrounding the anus and lower inch or two of the rectum.

The character of the blood-supply of this portion of the bowel, and the conditions under which it is carried on, go far to explain the frequency of this affection. The circulation in the lowest portion of the colon is similar to that in the intestine generally, the vessels being distributed transversely around the gut; but in the rectum they run in longitudinal series along the bowel, being connected by transverse branches, which form a plexus around and just above the anus. Their situation in the loose submucous tissue, where there is but little support, necessarily exposes them to great and sudden variations of pressure before and after defæcation. Their dependent position at the lowest part of the portal area, together with the absence of valves, and the fact that they constitute an important communication between the portal and general systems, and thus afford the chief means of escape from a block on the portal trunk—all these reasons may be looked on as **Predisposing Causes** of the con-

In addition to these we must also mention a sedentary
n, alcoholic excess, and chronic constipation, which, by
congestion of the liver, are frequent precursors of piles.
exceedingly common in young people, especially in men
nty years of age forced to lead a sedentary life; up to
e the tendency diminishes, but in elderly individuals many
, *e.g.*, enlarged prostate, or stone in the bladder, arise
our their development. Simple stricture of the rectum or
disease may so interfere with the return of blood as to
a development of hæmorrhoids. Young women are re-
exempt from piles, owing probably to the regularity of the
discharge; but uterine conditions, such as pregnancy,
nts, or tumours, which cause obstruction to the venous
liable to be associated with them.
se condition of the veins in the neighbourhood of the anus
resent without being recognised by the individual; but
rent circumstances may bring the symptoms into promi-
ausing an attack of thrombosis, such as the use of drastic
, especially aloes, local exposure to damp and cold, as by
a cold wet stone or in a draughty closet, or sudden con-
the liver, as by alcoholic excess, or a chill.
ef varieties of piles are described, viz., the external and
ut frequently a combination of the two conditions is

al Piles are found at the margin of the anus, and are covered
n. They consist of a small central vein in a varicose state,
ed by a development of subcutaneous fibro-cellular tissue,
tter is much more abundant than the vascular element; in
practically consist of longitudinal folds of skin of a dark
lour radiating from the anus, and superficial to the sphincter.
ual relaxed state in which they are found they give rise to
oms beyond a little pruritus, and perhaps a sense of fulness
ation immediately before and after defæcation. They are
le, however, to become *inflamed* from local irritation or cold,
appear as tense, bluish, rounded swellings, exceedingly
nd tender, and often preventing the patient from walking or
comfort. In such a state the vein contained in the pile is
with blood-clot. Under suitable treatment the swelling
in a few days, usually leaving the fleshy fold more bulky
r than previously, owing to the partial or complete organi-
the thrombus.
eatment of external piles, when uninflamed, is very simple.
ion must be relieved; the parts should be kept clean and
ed; a hamamelis ointment or extract may be occasionally
nd great care taken not to irritate the anus after defæcation
e of hard paper (*e.g.*, newspaper). Very soft curl-paper,
pled, should be employed, or preferably absorbent wool.
rarely that *operative measures* are required in a simple case of
iles; where, however, external and internal piles co-exist,

it is advisable to complete any operation undertaken for the latter condition by the removal of the more prominent fleshy folds surrounding the anus. This is accomplished by grasping them with forceps, and snipping them away by scissors in a direction radiating from the centre of the anus. We would warn the practitioner, however, against too free a use of the scissors, whereby a subsequent contraction of the anus may be induced. For inflamed external piles the patient should be kept in bed, the bowels opened by a copious warm enema, and fomentations applied. If the pain and tension are very great, the tumour should be incised and the clot turned out; the margins of the fold may then be cut away, and the wound dressed.

Internal Piles consist of dilated veins held together by a certain amount of connective tissue, and covered by mucous membrane. At first they are quite soft and compressible, and easily emptied on pressure; but when they have existed for some time the connective tissue may be increased in amount, and arterial twigs are often found running into the mass.

FIG. 419.—INTERNAL PILES.

The condition is limited to the lower 2 inches of the bowel, and may present very varied appearances in different cases. Thus, there may be a general varicosity of the veins in the submucous tissue without the formation of any distinct tumours. The mucous membrane is then of a deep claret colour, somewhat thickened, and liable to protrude during defæcation. There is a certain amount of glairy mucous discharge, and the fæces may be streaked with blood; but, as a rule, the hæmorrhage is not great. Such a condition is usually followed by a definite formation of hæmorrhoidal tumours, and not unfrequently runs on to prolapse.

When distinct hæmorrhoidal masses form, they may be of two types: (*a*) The *longitudinal* or *fleshy pile* (Fig. 419), consisting of broad sessile masses, dusky in colour, soft and compressible in consistency, and usually covered by mucous membrane, which, although thin and stretched, still remains smooth and shiny, like the skin of a black grape. Between the piles depressions are found, in which small portions of fæces may lodge and produce irritation. This form usually bleeds but little. (*b*) The *globular* or *bleeding pile* is single or multiple, and usually somewhat pedunculated; the surface of the tumour is roughened and granular, like a strawberry, due to the existence of dilated capillaries. When, however, a portion of it has been repeatedly protruded, the exposed mucous membrane becomes hard, and practically converted into skin, and the columnar epithelium may be replaced by the squamous type. The hæmorrhage is often abundant, and comes either from the dilated superficial capillaries, or occasionally from a central arterial twig.

The **Symptoms** arising from internal piles are often not very marked

norrhage occurs; but there is usually a sense of weight or
bout the anus, with sometimes pain, which is increased
d after defæcation. The patient feels as if a foreign body
ent in the bowel, and the mass not unfrequently protrudes,
e to much pain and inconvenience until replaced by the
wing to the grip of the sphincter. Sooner or later hæmor-
lmost certain to be noticed, coming on at first after defæca-
only a few drops being lost. After a time, however, the
ases, and may continue to such an extent as to cause
æmia. If the case remains untreated, the pain and incon-
increase; a blood-stained mucous discharge from the
noticed, soiling the linen; reflex irritation of neighbouring
produced, and a condition of nerve prostration from pain
rrhage may result. In cases where the piles are due to
struction, as in cirrhosis of the liver, the bleeding may be
l, and must not always be checked. Moreover, when the
al flow is diminished, a vicarious discharge of blood from the
sometimes observed.

lications of Piles.—*Inflammation* of the venous ampullæ con-
a piles leads to what is popularly termed an 'attack of piles,'
h this is much less common with the internal than the ex-
riety, and the fleshy form is that usually affected. Evidences
lized phlebitis manifest themselves in the shape of a painful
n and swelling of the parts, which become blue in colour
uisitely sensitive. They subside with or without suppura-
the latter case a spontaneous cure may result, whilst in the
eneral blood contamination may follow, death from pyæmia
even occurred. *Strangulation* of the piles by the sphincter
follow protrusion where reposition is not effected, the mass
coming painful, tense, swollen, and livid in colour; inflam-
running on to ulceration and even sloughing follows, the
suffering meanwhile from sickness, pain, and toxæmia.
is likely to ensue unless the case is effectively treated, pre-
y pylephlebitis (*i.e.*, septic inflammation of the branches of
l vein in the liver). On the other hand, a spontaneous cure
effected. *Prolapse* may become chronic, and *fissure* of the
elop.

Diagnosis of piles from other swellings which occur in the
rhood is not difficult. From *prolapse* they are recognised
irregularity, the swelling not being of a rounded smooth
variety, as in the former case; the two conditions are, how-
en associated. From *polypus* piles are distinguished by
ultiple rather than single, by being softer and more com-
, by their situation close to the anus, by the absence of a
and by the hæmorrhage being usually more marked.
bercles and *condylomata* are often mistaken for external piles,
easily recognised by being symmetrically placed, owing to
of one lip of the gluteal fold from the other, by their moist
and their situation at a little distance from the anus. The

consistency, appearance, and history of an *epithelioma* should effectually prevent any error in diagnosis.

It is important also to remember that blood may be passed *per anum* from many other conditions besides piles. In the latter case the blood is of a bright red, florid colour, and often coats the fæces, whereas if it originates higher in the intestinal canal it is dark or tarry in colour (*melæna*), and is more intimately mixed with the excreta. A digital examination of the rectum will also in the latter case eliminate the presence of piles.

The **Treatment** of internal piles is both general and local.

General Treatment consists in removing all possible sources of venous congestion, in regulating the bowels, and assisting the functions of the liver. The latter may be effected by the judicious administration of natural mineral waters, such as Hunyadi Janos and Friedrichshall, or by the use of some such mild aperients as the confections of senna and sulphur, or castor oil. These may be given daily, whilst at the same time the food and drink of the individual are regulated, all excess of alcohol being avoided, and suitable exercise enjoined. In weakly and debilitated individuals it is advisable to adopt a more stimulating and tonic plan of treatment. Aloes should generally be avoided. When dependent on the pressure of a gravid uterus, little can be done beyond attending to the regular action of the bowels until the child is born.

Local Treatment in the earlier stages consists merely in *palliative* measures. Thus the parts must be protected from injury and cold; only soft paper or cotton-wool used after defæcation; and, when protruding, the piles should be sponged with cold water and gently returned. An ointment containing an extract of witch-hazel (hamamelis), or the injection of a hazeline lotion (1 in 8), is also advisable, and bleeding from piles can often be arrested by this means. The Ung. gallæ c. opio of the Pharmacopœia is recommended, but is not so efficacious.

When there is much pain or bleeding, and the piles have attained some size, **Radical Treatment** by operation is necessary. Care must be taken before advising it to ascertain the condition of the liver, as the bleeding may be beneficial in relieving hepatic congestion, and an operation is then injudicious and harmful. In all cases the bowels are thoroughly emptied by a dose of castor oil given the night before and an enema on the morning of the operation, whilst the patient sits over hot water for half an hour beforehand. The lithotomy position is adopted, the perineum is shaved and cleansed, and the surgeon thoroughly stretches the sphincter by introducing the two index fingers and then separating them forcibly, by this means bringing into view the whole of the diseased area of mucous membrane, which never extends beyond 2 inches from the anus. The following plans of treatment are those chiefly used:

1. *Removal by clamp and cautery*, as introduced by the late Mr. Henry Smith. The mucous membrane having been everted, as just described, each of the hæmorrhoidal tumours is grasped by a pair

ded catch forceps, and thus temporarily secured; by this
: scope of the operation required can be readily gauged.
) is then applied to each mass successively in a direction
ling to the long axis of the gut, great care being taken not
the external skin. The clamp is tightened by the screw
ɔ its handle, and the projecting mass of the pile removed
i. The cut surface is then thoroughly seared by a cautery
ɜd heat, and the pressure of the clamp slowly relaxed, so
rtain that all bleeding has ceased. External piles may be
way as indicated above (p. 1142), the mucous membrane
, the parts dusted with iodoform, and a carefully graduated
of antiseptic wool applied with a T-bandage. The parts
each day with some mild antiseptic lotion, and should be
ten to fourteen days. The use of the catheter may be
for the first forty-eight hours after a severe case, owing to
of urine. The bowels are not opened until the fourth or
, and then a good dose of castor oil (*e.g.*, 1 ounce in adults)
e administered. It is better to allow the patient to sit on a
e for the evacuation of the bowels. From a very large ex-
of this operation, gained both at hospital and in private,
no hesitation in maintaining that, if efficiently carried out,
bined with the use of a powerful and properly constructed
ump, it is absolutely safe and free from danger; that any
tions from sepsis, hæmorrhage, etc., are due to the careless-
he surgeon, and not to the character of the operation; and
ll practical purposes it is the best means of dealing with
iles.

ature is also an operation much in vogue for the treatment
and as now carried out with due antiseptic precautions, a
ount of success attends its use, although it is doubtful
recovery is as speedy or painless as after the cautery. The
oidal tumours are grasped by forceps, the mucous membrane
round them, and the base ligatured with silk; the mass is
ped off, and the ligature cut short, the knot being allowed
te by subsequent ulceration.

shing by means of a powerful clamp has also been recom-
by Benham, Allingham, and others, the base of the mass
oroughly compressed, and the pile then cut away. We
afer to combine such treatment with the styptic and anti-
alities of the cautery.

ere the veins of the lower inch or two of the mucous mem-
e in a varicose condition, but no definite hæmorrhoidal
are present, *Whitehead's operation* may be employed. It
n the total removal of this pile-bearing area in the same
r excision of the rectum. An incision is made round the
f the anus at the junction of the skin and mucous membrane,
tter dissected up from the muscular coat of the bowel by
e snips of the scissors; it is then cut away, all bleeding-
secured, and the lower end of the divided mucous mem-

brane united by suture to the skin, the stitches passing deeply under the surface of the wound and not merely through the margins. Excellent results have followed such treatment in suitable cases.

Rectal Prolapse.

A certain tendency to eversion of the mucous membrane of the bowel is a constant and normal accompaniment of the act of defæcation; if, however, this becomes abnormally increased, the condition may be maintained after the evacuation of the bowels is concluded, constituting a condition of prolapse. At first only the mucous membrane is protruded, and this is known as an *incomplete* prolapse; if, however, the condition persists, the whole thickness of the bowel may become involved, mucous membrane, submucosa, and even the muscular and serous coats, giving rise to the *complete* variety (Fig. 420). The former condition (sometimes badly termed a prolapsus ani) is more commonly met with in adults, and the latter (the so-called prolapsus recti) in children; but it must be understood that the latter is always preceded by an incomplete stage, limited to the mucous membrane, and that in adults complete prolapse is occasionally observed.

Causes.—1. It may be produced by a simple relaxation of the tissues, as met with in weakly individuals, and those who have been much exposed to the debilitating effects of residence in tropical climates, especially when chronic constipation or diarrhœa has caused the evacuation of the bowels to be accompanied by straining efforts. 2. Conditions which have led to chronic tenesmus or violent expulsive efforts, *e.g.*, piles, chronic constipation, diarrhœa, rectal irritation, as from worms in children, or diseases of neighbouring organs, such as vesical calculus, stricture, or enlarged prostate, may also determine prolapse.

Symptoms and Diagnosis.—The anal orifice is occupied by a smooth rounded swelling, red or purplish in colour, covered by mucous membrane; this protrusion in the early stages can be easily replaced by a little pressure, but returns if the patient strains or coughs. When the swelling is of large size, reduction is increasingly difficult and painful from infiltration and fibrous overgrowth of the submucosa, and it is very liable to become inflamed and ulcerated from friction. Incontinence of fæces is also a common result. When the whole thickness of the gut is protruded, the serous lining may accompany the tumour, but this is usually limited to the anterior surface, and into the sac thus formed small intestine or omentum may pass, and even become strangulated (Fig. 420, X). The prolapse itself may also be constricted if allowed to remain for long unreduced; the mass is then livid, swollen, and intensely painful, and if left to itself may slough away, and thus lead to a spontaneous cure, although severe septic symptoms may supervene, and even perforative peritonitis.

There should be but little difficulty in recognising a prolapse; the only condition for which it can be mistaken is an intussusception pro-

he anus; in such, however, the finger or a probe can
the rectum by the side of the protruding gut, which
ith a prolapse.

In the earlier stages, all that is needed is the removal,
he cause of the tenesmus, *e.g.*, dilatation of a urethral
val of a vesical calculus, or the regulation of the
o check either chronic
nstipation. When piles
ay should be treated as
s, and the prolapse will,
bsequently disappear.
must be dealt with by
(*q.v.*). Beyond this,
ent injections may be
sulphate of iron (1 to
nce), and it is advisable
al to acquire the habit
aily motion at bedtime,
are made to defæcate
de, one buttock being
he purpose. The pro-
lly washed, reduced by
he fingers, and retained
ie nates together, par-
ildren, or by applying
pad and a T-bandage.
r in obtaining a cure in
ts in never allowing the prolapse to remain unreduced
of time.

FIG. 420.—LONGITUDINAL SECTION OF COMPLETE PROLAPSUS RECTI. (TILLMANNS.)

× indicates the serous sac in the anterior wall due to protrusion of the peritoneum.

alliative measures fail, **Operative Treatment** must be

ter cases of incomplete prolapse, it will suffice to
ze of the anal orifice by snipping away radiating folds
cous membrane, and allowing the wounds thus pro-
trize. In the worse cases it may be necessary, in
iove strips of the mucous membrane in a longitudinal
eans of the clamp and cautery; or a larger area of
all of the prolapse may be denuded of its mucous
he edges brought together by deep stitches. Where
, or is thought undesirable, the prolapse may be dis-
incising the circumference of the anal orifice at the
skin and mucous membrane, and turning down the
he mucous coat like a cuff. A finger inserted in the
o draw down all the slack inner lining, and to ascer-
ig is present but the mucous membrane. The whole
d portion is removed by scissors, all bleeding points
s divided; the upper edge of the mucous membrane
y suture to the cutaneous margin of the anal orifice.
total prolapse of the bowel in children, nothing but

alliative treatment is generally necessary; but in adults a modification of the above-described operation is required. The patient's buttocks are well raised, so as to prevent any protrusion of intestine if the peritoneal cavity is opened. The base of the prolapse is divided anteriorly on a level with the anus, the opening in the peritoneum temporarily packed with sterilized gauze, and the remainder of the mass removed by scissors, bleeding points being secured as divided. The serous cavity is then carefully closed by sutures, and the divided end of the bowel united to the skin at the anus. No motion is allowed to pass for a week, but the anal orifice and lower gut should be thoroughly washed out twice or thrice daily to prevent accumulation of septic material. Control over the bowel is usually regained, though often somewhat slowly, and the after-treatment is likely to be prolonged.

In bad cases the prolapse often recurs after operation, and it is then desirable to cut down on the sigmoid flexure from the groin and anchor it by sutures to the abdominal wall (*colopexy*). Not unfrequently prolapse of the uterus accompanies the rectal lesion, and then a median incision should be made, and the uterus fixed to the anterior abdominal wall (*hysteropexy*), and the rectum sutured either to the back of the uterus or to the abdominal parietes.

CHAPTER XXXVIII.

SURGICAL AFFECTIONS OF THE KIDNEYS.

ys are placed on either side of the middle line, and extend
ıth rib above to midway between the last rib and the iliac
v, the right kidney being somewhat lower than the left
ae presence of the liver. The hilum is situated opposite
as process of the first lumbar vertebra, and the upper ends
gans are nearer to the spine than the lower.

al examination of the kidney is made with the patient lying
ack, with the legs raised and the head supported by a pillow;
th is left open. The surgeon, kneeling or standing at the
:he couch, places one hand under the loin and presses it
, whilst the other is gently but firmly pressed backwards in
ar region, especially during expiratory movements. Un-
nlargement or displacement downwards of the organ will be
detected, as also irregularities in outline or modification of

ılarged kidney is recognised by the following general
rs: A swelling is noticed in the loin, which is shaped more
ke the kidney, a notch being occasionally, though rarely, felt
ner border, and the outer margin being rounded. The flank
dull on percussion, the note remaining unaltered whatever
nt's position, and intestine never finding its way behind the
The passage of the colon in front of the kidney not unfre-
ives rise to a band of resonance over its anterior surface;
l, however, soon gets pushed aside by the growth of the
On the right side it is not unusual for the renal dulness to
uous with that due to the liver. The mass moves slightly
ation, though less distinctly than the liver or spleen; and
e can be felt passing down towards the pelvis.
left side it has to be distinguished from an enlarged spleen;
viscus hugs the anterior abdominal wall, and has no gut
f it, whilst the loin is usually resonant.
t uncommon, however, to find cases where physical examina-
is type reveals but little, and although one may suspect the
f being the cause of some modification of the urinary secre-
, hæmaturia or pyuria—it may be difficult to be certain as

ides as it enters the bladder. To act effectively the curved be pressed well backwards against the posterior vesical wall. lneys may be exposed by two chief routes, viz., the lumbar bdominal.

umbar incision (Fig. 422, B) commences at a point corre- to the outer border of the erector spinæ, and ½ inch below b, extending downwards and outwards in the direction of of the external oblique he anterior superior ıe. The posterior of the abdominal ınd the fascia lum- divided *seriatim*, and ssue surrounding the thus easily reached d.

dominal incision is ıg the linea semilu- ıch is divided, and the l cavity opened. If a lies over the kidney, splaced inwards and le, as also the other s, by cloths soaked in lt solution; the peri- covering the posterior al wall is incised to side of the colon, and thus exposed. When, the kidney is large, it is often unnecessary to open the l cavity, the colon and other peritoneal contents being inwards.

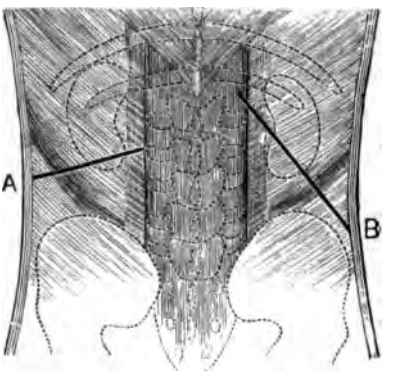


FIG. 422.—DIAGRAM TO ILLUSTRATE LUMBAR INCISIONS.

A, For lumbar colotomy; B, for exposing the kidney.

l method has been advocated by some surgeons, known as ral or **Lumbo-abdominal**. The incision extends vertically tip of the last rib to the iliac crest, and, if necessary, a is made backwards at right angles to it. The peritoneum d forwards from the kidney, the operation being thus retro- l. The advantage over the ordinary lumbar incision has, yet to be demonstrated.

al Affections of the Kidney.—Many different malformations and dis- are met with affecting this organ.

f Malformations are as follow: (*a*) Complete absence of one organ, condition, and (*b*) congenital atrophy of one kidney, it being repre- mass of fatty tissue; in both cases the other organ is correspondingly nd hypertrophied. (*c*) The kidneys may be fused together, either one large organ in the median line, and more or less normal r sometimes constituting the so-called horseshoe-shaped variety, the eing directed downwards. (*d*) Deep lobulation of the kidney, as in als, is sometimes seen, especially if the organ is displaced; occa- is carried to such an extent as to divide it into two or more portions. ter and pelvis may be double, this malformation affecting the pelvis

alone, or extending as far as the bladder. (*f*) The renal artery may arise from the aorta in two or more main branches.

The majority of these malformations are of very little clinical importance, except in the operation of nephrectomy, when they may necessitate some modification of the usual proceedings.

Congenital Displacement of the Kidney occurs about once in every thousand individuals, the organ being either depressed, so as to lie over the sacro-iliac synchondrosis or sacral promontory, or raised above its normal position. The left kidney is more frequently affected in this way than the right, and, when lying in the iliac fossa, the descending colon is usually displaced inwards, so that the rectum starts to the right of the middle line. The adrenal bodies retain their normal position, and do not move with the kidney.

Cystic disease, sarcoma, and hydronephrosis may also occur congenitally, and will in turn be described below.

Floating and Moveable Kidney.—The normal kidney is not a fixed organ, but moves up and down on respiration, although usually such movement cannot be detected on palpation. It is therefore necessary to define as precisely as possible what is meant clinically by the terms 'moveable' and 'floating' kidney. Three stages of abnormal mobility may be described: (i.) A *palpable* kidney is one the lower half or more of which can be definitely felt on deep inspiration. (ii.) A *moveable* kidney is one in which the examining hand can define the upper end of the organ, and can restrain it from returning to its old position during expiration. (iii.) A *floating* kidney is one which can be moved freely about the abdomen in all directions, and even across the middle line in some cases. Formerly this last term was applied to a supposed congenital lesion, in which the kidney was attached to the posterior abdominal wall by means of a mesentery; it is more than doubtful whether such a condition exists.

In the earlier stages the movements occur within the fatty capsule which surrounds the organ, but later on mild attacks of inflammation attach the fatty to the fibrous capsule, and the kidney with its associated fatty envelope moves behind the peritoneum. Two forms of movement are possible: (i.) An up-and-down or in-and-out movement in one plane (*cinder-sifting* movement), the kidney merely swinging on its pedicle; or (ii.) a movement of torsion may accompany this, either round a transverse axis when the lower end of the kidney becomes prominent, or round a vertical axis when the outer convex border swings forwards. In the latter case kinking of the ureter or renal vessels is very likely to ensue.

Moveable kidney occurs more frequently in women than in men (10 to 1), and more often on the right than on the left side (12 or 13 to 1), partly because the renal vessels are longer on this side than on the other, and partly because the descending colon is more fixed than the ascending.

Causes.—The kidney is normally kept in position by a firm packing of fat between the layers of the perinephric fascia; but in addition the tension of the peritoneum, the maintenance of the intra-abdominal pressure, and the support of the muscular abdominal parietes, have much to do in keeping it in place. Anything that seriously modifies

se factors may lead to displacement and mobility of the
parturition accounts for many cases; firstly, because of the
minution of the intra-abdominal pressure, and, secondly,
he resulting pendulous and relaxed state of the abdominal
specially if the patient too early resumes the erect posture,
akes physical work without efficient external support;
more frequent among the poor than amongst the rich. It
follow the removal of large abdominal tumours which
abdominal walls, or rapid emaciation, whereby the peri-
t is absorbed, whilst tight-lacing or traumatic influences
sponsible for some cases. It is frequently associated with
of displacement downwards of the abdominal viscera which
s Glenard's disease, or enteroptosis.

ns.—A moveable kidney is often discovered by accident,
rely free from symptoms. In some cases the patient comes
rvation because she has observed a moveable lump in the
which on handling is painful, the pain being often associated
a and vomiting. In other cases the pain and vomiting
atient under observation, the doctor discovering the move-
y. The pain is referred to the back, or perhaps shoots
uréter to the groin, testis, or labium majus. Vomiting is a
sign, and the surgeon should never omit to examine the
es of obstinate vomiting with no apparent cause. Periodical
ons of these symptoms, with a temporary diminution in
t of urine, result from kinking of the ureter (*Dietl's crises*);
ief, followed by an increased flow of urine possibly contain-
muco-pus, indicates that the organ has returned to its normal
Repeated attacks of this type may result in pyelitis and
rosis. On examining the abdomen, a moveable tumour can
served with ease if the abdominal parietes are not loaded
nd on manipulation pain and vomiting may be induced.
ion of the genu-pectoral position will sometimes enable a
kidney to be more certainly felt, whilst a distinct loss of
is noticed external to the erector spinæ on the affected side.
ient is almost always very neurotic, and evidence of the
nt of other abdominal viscera is often found, so that the
f a moveable kidney does not necessarily explain the whole
licate operation. Many a patient has been operated on for
idney, but the symptoms (pain, vomiting, etc.) persisted,
the organ remained anchored to the abdominal wall.

nt.—It must be fully recognised that in the great majority
which unnatural mobility of the kidney can be detected
s not required. Only when it can be definitely established
dney is the real source of the symptoms should operation
ed, and even then it may be possible to deal with it by
s. Pressure will sometimes restrain the mobility of the
this is best applied by means of an air cushion incor-
an abdominal belt; the cushion should be triangular, its
sponding to the costal border, Poupart's ligament, and the

linea semilunaris; it is put on in the recumbent posture, and for choice with the pelvis raised. If prior to the use of this appliance the patient will submit to a stay in bed, with a course of abdominal massage and Swedish exercises, and be fed up well, so much the better.

If, however, the organ is so tender that the needful pressure cannot be borne, or if evidences of hydronephrosis or pyelitis are present, or if the kidney is extremely mobile and handling causes vomiting, etc., then operation may be wisely recommended, and in suitable cases does much good. *Nephrorrhaphy or Nephropexy* is the name applied to this procedure. It is obvious that a rounded structure like the kidney with a smooth fibrous capsule is not easily fixed, and the more so since the renal parenchyma has great absorbent power, so that sutures, even of silk, passed through its substance are early disintegrated and absorbed; hence, although the kidney may seem to be efficiently immobilized at the completion of the operation, it readily becomes loose again. There are only two certain methods of fixing the organ. (i.) The wound down to the kidney is left open and packed with gauze so that healing occurs by granulation; the cure is certain, but tedious, whilst a lumbar hernia may follow. (ii.) The plan now usually adopted is to expose the organ by the lumbar incision. The fatty covering is opened, and as much of it as possible removed. A portion of the true fibrous capsule is now dissected up and fixed to the abdominal parietes so as to expose the raw and slightly bleeding cortex. Many methods of dealing with the capsule have been suggested, but it matters little which is employed. Personally, we prefer to strip up a good-sized flap from the centre of the organ and fix it by stitches between the divided muscles, whilst a deep suture is passed through muscles and kidney above and below the bared area. The organ is thus firmly fixed, but it is wise to keep the patient in bed for four or five weeks subsequently to allow of consolidation, and afterwards a binder or belt should be worn for a time.

Injuries of the Kidney are usually due to crushes of the body, as between the buffers of railway cars, or when a cart passes over the abdomen, or from blows or falls. Considerable hæmorrhage follows, both into the substance of the kidney or its pelvis, and into the perinephric fatty tissue, and this even when the capsule has not been torn. The integrity of this structure is a point of great importance, since it limits to some extent the bleeding and prevents urinary extravasation; the kidney may be crushed to a pulp without any external hæmorrhage, and under these circumstances clots are likely to pass down the ureter, and may obstruct it and lead to its subsequent occlusion. When the anterior portion of the capsule is torn, the peritoneum may also be involved, especially in children, and then evidences of intra-peritoneal bleeding may manifest themselves, and, indeed, if the kidney is extensively lacerated, fatal hæmorrhage may result, though this is unusual. Rupture of the posterior surface of the kidney opens up the retro-peritoneal cellular tissue, which becomes infiltrated with blood and urine, and suppuration is almost certain to follow, resulting in pyæmia or at a later date in exhaustion from

ptic poisoning. Not unfrequently other severe injuries are
uch as fracture of the pelvis, spine, or skull, bruising or
intestine or liver, and from these associated lesions serious
ia may arise.

mptoms consist in severe shock, followed by nausea, vomit-
in the loin, shooting down into the testis or thigh, localized
s and perhaps swelling over the injured organ, and hæma-
he amount of blood lost in this way varies considerably; in
er cases the hæmaturia is of short duration, but in more
lesions it may be severe and so persistent as to threaten life.
age of clots down the ureter gives rise to renal colic, and
n of that duct may lead to total suppression of the secre-
e affected side. The bladder may in some cases become
stended with clots, the blood coagulating after it has entered
. Hæmorrhage into the perinephric tissues is indicated by
tion of a swelling in the loin, and laceration of the peri-
followed by distension of the abdomen, increasing anæmia
sisting hæmorrhage, and the onset of peritonitis. The
ent of a perinephritic abscess is recognised by fever, rigors,
pain in the loin, and the usual phenomena of deep sup-
(p. 1162).

reatment usually required is to keep the patient quiet in bed,
icebag or Leiter's tubes applied to the loin; pain may be
by strapping the side or by applying a firm bandage. Per-
emorrhage necessitates the administration of ergot, tannic
urpentine; but if it is threatening the patient's life, an ex-
incision is required, and, if need be, removal of the organ,
it is sometimes possible to stitch up a limited rent, the
eing passed deeply through the organ. Any distension of
ter must be relieved, the clots being washed out through a
d catheter. The occurrence of peritonitis or of a peri-
abscess will call for suitable surgical measures, the injured
ing dealt with according to its condition.

e of the Ureter is a rare accident, usually due to direct violence,
sionally happening during pelvic operations, such as removal
terus. When due to a subcutaneous injury, it cannot be
d at once, but extravasation of urine takes place, resulting
rmation of a perinephritic abscess. This is incised sooner
and on exploring the cavity it may be possible to detect the
he ureter, but more frequently its situation cannot be found,
a doubt will necessarily exist as to whether the lesion in-
e ureter or the pelvis of the kidney. In either case a urinary
the loin results, which may possibly close after a time; if
a persists, nephrectomy will be required, and then the sooner
operation is undertaken the better. In a few favourable
as been possible to suture the rent in the ureter by the fol-
an: The lower end of the divided ureter is closed, the exposed
membrane being tucked in by sutures passing through the
coat; the upper end is then implanted into a longitudinal

opening made in the side of the lower segment, and accurately stitched in position.

Two cases probably of this nature came under treatment at hospital. Both occurred in young boys, and both were due to cab accidents. In the first, after the preliminary shock had passed off, nothing special was noted for about ten days, when on sitting up sharp pain was experienced in the side, and this was followed by a retro-peritoneal collection of fluid, together with some amount of fever. On incision a large quantity of limpid urine escaped, with but very little pus—an interesting illustration of the fact that healthy urine does comparatively little damage to tissues into which it is extravasated. The finger introduced into the wound passed beyond the middle line, and the ureter could be felt traversing the cavity; but the rent could not be found. Drainage was provided, and for a time a urinary fistula persisted; finally, the wound healed completely. In the second case the inflammatory phenomena were more marked, but an incision was not made until the twelfth day; here also the lesion could not be found, and drainage was resorted to, but without avail, nephrectomy being subsequently required. Both cases recovered.

Hydronephrosis is a condition characterized by distension of the pelvis and calyces with urine, as a result of some obstruction to its exit.

Causes.—(i.) It may be *congenital* in origin. It must be borne in mind that the body of the kidney is developed from the metanephros, and that the ureter unites subsequently with it to form its excretory duct; such union is occasionally defective at the upper end, well-marked obstruction occurring at the junction of the ureter with the infundibulum of the pelvis. Similar trouble sometimes arises from the ureter becoming kinked over an abnormally-placed renal artery. It is, however, more frequently due to an impervious condition of the urethra or to the existence of a membranous septum therein; both kidneys are then necessarily affected. The amount of distension in some of these cases is such as to interfere seriously with parturition until the abdomen has been tapped. The infants are often born dead, or succumb shortly after birth. (ii.) *Acquired* forms of obstruction are by no means uncommon, and may be arranged under the following headings: (*a*) Blocks within the urinary passages from the presence of stones, parasites, foreign bodies, or even blood-clot; (*b*) changes of structure affecting the walls of the urinary passages, *e.g.*, inflammatory swelling of the mucosa, cicatrices, stenosis, or tumours; (*c*) kinking of the ureter in cases of floating kidney; and (*d*) the pressure of extrinsic tumours or cicatrices, as after pelvic cellulitis. Hydronephrosis may be unilateral or bilateral; in the former case the obstruction arises within the ureter, or from some vesical condition involving its entrance into the bladder; in the latter case the cause is generally to be looked for below this spot.

It must be clearly understood that a sudden and absolute block never leads to hydronephrosis. Should it occur as the result of impaction of a calculus in one of the ureters or of ligature of the ureter, as has occurred in hysterectomy, the secretion on that side is totally suppressed as soon as the tension within the pelvis and calyces is sufficiently high. Atrophy of the renal epithelium follows after a time, but if the obstruction is relieved within six weeks of its incidence, the secretion of urine will probably be re-established. Should,

, the obstruction be intermittent or incomplete, so that some ine escapes, thereby relieving the pressure, hydronephrosis . Sudden and complete occlusion of the urethra likewise i dilatation of the bladder and rupture either of that viscus urethra, whilst a gradually increasing obstruction is always lead to hydronephrosis.

gical History.—The earliest result of obstruction to the rine consists in dilatation of the ureter and pelvis, which is wed by expansion of the calyces. The pyramids are flat- d the cortex expanded and thinned, so that the whole kidney rger than usual. A amount of interstitial n of the cortex is present; the urine in the early stages is bundant and of a low ravity.

obstruction continues, tissue becomes more atrophied, until finally ars entirely, the kidney presented by a thin- ultilocular cyst. At any ptic phenomena may e, giving rise to pyone- *vide infra*).

FIG. 423. — HYDRONEPHROSIS. (FROM SPECIMEN IN BRISTOL HOSPITAL MUSEUM.)

linical History varies bly with the method of d the cause of the Frequently all that is a painless enlarge- the affected organ; if involved, there may be at first some increase in the amount ecreted, which is pale, limpid, and of a low specific gravity; me the quantity diminishes, and finally anuria and uræmia specially if septic changes supervene, as is so commonly . When only one kidney is affected, the excretion may normal in quantity and quality, owing to compensatory hy of its fellow. Not unfrequently a fluctuating swelling erable size is produced by hydronephrosis; it presents all ical signs of a renal tumour (p. 1149), and its formation is sociated with pain, vomiting, and increased frequency of on. Finally, a perinephritic abscess may develop, owing tion of the pelvis or ureter, and the cyst may thus discharge the loin. Occasionally the size of the tumour varies con- from time to time, owing to the obstruction being tem- overcome by the pressure of retained urine behind it.

reatment of hydronephrosis should in the first place be to removal of the cause, if practicable, and where the

infection upwards is rendered more difficult. It is probable, that the mucous membrane lining the orifice becomes ımed, and a small plug of mucus develops within it, through e germs are able to pass upwards. In other cases they find their way *viâ* the lymphatics of the mucous membrane, ı continuous in the ureter and bladder. When the phenomena y this infection from below are limited to a suppurative , it is known as an *ascending pyelonephritis;* but if to them is element of distension, due to the cause being of an obstruc-, then the distended suppurating kidney is known as a is. (iv.) Sometimes the infection reaches the urinary from neighbouring organs, though this is certainly un-

We have known an appendix abscess to open through y and discharge itself, or to involve the ureteral wall.

ganisms usually present are staphylococci, streptococci, or *li*, which, as we shall see later on, is constantly associated ımmation of the bladder.

litis is the term applied to an inflammation involving the the kidney, the calyces, and perhaps the ureter. The chief om which it arises are: (*a*) The presence of a calculus, or ge of uric acid crystals in gouty individuals; (*b*) tuberculous ıther starting primarily in the kidney, or extending upwards bladder; (*c*) extension of septic inflammation from the ınd urethra; (*d*) malignant disease of the kidney; (*e*) occa-ı floating or moveable kidney; (*f*) the ingestion of irritating g., cantharides, turpentine, and even cubebs or copaiba; resence of foreign bodies, such as needles, bullets, and para-the *Bilharzia hæmatobia* or the *Strongylus gigas;* (*h*) a pyæmic and (*i*) possibly cold. In the milder cases and in the early may be a simple catarrhal inflammation, but it is almost ı become of a purulent type if it lasts long.

ver the cause, the pathological phenomena are the same, g in the lining membrane becoming congested and thickened, ıting a muco-purulent, or even purulent, discharge. Owing elling of the mucous membrane, the entrance to the ureter ched on, and a certain amount of distension of the pelvis es (hydronephrosis) follows. Where micro-organisms are ıs in cases due to extension from the bladder, the kidney is be involved in the process (pyelonephritis), or the condition followed by a urinary abscess in the loin or suppurative itis.

mptoms of pyelitis consist of pain and tenderness over the kidney, increased frequency of micturition, and the *inter-*scharge of pus in *acid* urine. The intermissions are due to mmatory swelling of the mucous membrane, which tem-ılocks the upper entrance to the ureter, and necessitates a egree of pressure of the urine and pus accumulated in the the kidney in order to overcome the obstruction. Neces-ere pyelitis follows chronic cystitis, the acid reaction of the

more *chronic* cases, the symptoms correspond to those of a osis (*q.v.*), which condition is almost certain to be present. that the cause can be removed or satisfactorily dealt with, is quite possible in these cases, but the kidney is, of course, itly damaged, and some degree of sclerosis is certain to follow. ent.—In the *chronic* variety, the cause must be efficiently l, if possible, but the surgeon must not forget that an acute ay be easily lighted up by injudicious instrumentation or s. Hence it is desirable to drain and wash out the bladder, erineal cystotomy, rather than to dilate or divide a stricture thra. An enlarged prostate or calculus must be removed, be desirable to wash out or drain the bladder for a few days dertaking such operations, so as to diminish the risks of The patient is kept quiet and warm in bed, and is encouraged lenty of bland fluids. In the *acute* form, the essential element ent is to prevent the development of uræmia, and to diminish stion of the kidney and re-establish the efficient secretion of he patient is kept warm in bed, and is given plenty of bland as milk and barley-water; stimulants are avoided, as also Hot-air baths, wet packs, and the hypodermic injection of e, will suffice to get the skin to act well, and watery pur- uch as jalap and scammony, are needed for the bowels. are cupped or fomented; and it is an open question ie kidneys should not be exposed and their capsules removed, minish tension.

ephrosis is the term applied to indicate the association of a yelonephritis with distension of the pelvis and ureter, as a obstruction to the passage of urine. When unilateral, it is y due to the presence of a calculus, or of tuberculous he obstruction being due to the swelling of the ureteral embrane; if the affection is secondary to obstruction in the nary passages, it is usually bilateral. The lining membrane lvis is inflamed, thickened, and perhaps ulcerated; decom- ine and pus collect in the dilated pelvis and calyces, and a le, phosphatic calculus may develop in consequence, even where the originating cause is not of a calculous nature. on to the outlet may lead to such an accumulation of pus as ute an abscess of the kidney, whilst a certain amount of itis is always present.

Signs.—The kidney is found to be enlarged and tender on whilst more or less constant pain is present in the loin. perature is usually somewhat raised, especially at night, absorption of septic products; the patient steadily loses nd becomes emaciated; the tongue is dry, the appetite d, and nausea and vomiting are sometimes present. The sually scanty in amount, and loaded with muco-pus, which nstant or intermittent. If both kidneys are involved, the of urine gradually diminishes, leading to a fatal issue from nless the patient dies previously from toxæmia or pyæmia.

t bursts into the peritoneal or pleural cavities, or into the
If it comes to the surface, it is preceded by congestion
na of the skin. *Chronic perinephritis* gives rise to no charac-
mptoms until an abscess forms which is large enough to be
metimes it is of a simple type, and does not suppurate; but
y becomes adherent to surrounding parts, and to such an
to render nephrectomy difficult and dangerous.
ent in the suppurating variety consists in giving exit to the
ugh an incision at
r border of the
pinæ; the cavity is
refully examined,
cause of the sup-
if possible, deter-
d treated according
quisites of the case.

ulous Disease of the occurs in one of rms. (*a*) It may he course of **acute tuberculosis**, when ubercles are found the organs, but ise to no special s. The patient is child. Treatment, , is impracticable.

nay extend upwards similar affection of ler, and then almost y involves both s. The mucous e of the ureter be- ickened and trans- into œdematous on tissue containing , and that of the d calyces is similarly affected; finally, the renal parenchyma comes infiltrated with tuberculous tissue spreading from the s. The patients are usually young adult males, and their is explained by the frequency of genital tuberculosis. , enlargement of both kidneys is noticed, arising partly e deposit of tubercle within the organ and partly from on within the ureter. The symptoms caused by the renal cannot at first be distinguished from those due to the vesical Perinephritic abscess occasionally follows, and the patient n exhaustion, septic absorption, or uræmia. Treatment in es is of no avail.

FIG. 424.—TUBERCULOUS KIDNEY, SHOWING THICKENING OF MUCOUS MEMBRANE OF PELVIS AND URETER. (FROM SPECIMEN IN COLLEGE OF SURGEONS' MUSEUM.)

mary Tuberculosis of the kidney is generally unilateral, and

liquefied carbolic acid, and plugging the wound thus In other cases it may be possible to excise wedge-shaped he renal cortex, securing the wounds by sutures. In the of instances, however, the disease will have spread much ively for such conservative treatment, the kidney practically of a series of cysts filled with offensive pus. If the tolerably certain that the other kidney is healthy, nephrec- uld be performed, care being taken to divide the ureter farthest limit of the disease. The occurrence of a peri- abscess necessitates an incision in the loin, and through this he kidney can be explored and, if necessary, removed.

alculus.—Renal Calculi are usually met with in individuals from lithiasis, as indicated by the passage of sand or gravel ine. The general causes of this condition are detailed (p. 1195). All oncretions are excreted in a form from the ules, but under circumstances iently small to way into the the kidney, and ong the ureter dder. If, how- are obstructed onward course, account of their hape, or some of the tubules, become lodged idney substance of the calyces, he gradual de- the same ma- crease in size e enough to give rise to symptoms (Fig. 425). Renal calculi ly not of great bulk, rarely exceeding that of a Barcelona sionally, however, the whole of the pelvis, and some of es, may be occupied by a concretion, which takes the the cavity in which it lies. When many calculi are n the pelvis of the same kidney, they are usually faceted. ly they consist either of uric acid or urate of ammonium; s, however, they are composed of oxalate or acid phosphate

FIG. 425.—CALCULOUS KIDNEY. (COLLEGE OF SURGEONS' MUSEUM.)

thological Phenomena connected with renal calculi vary with , shape, number, and position. If situated in the substance mal parenchyma, they give rise to but little change, being less encapsuled in a cavity lined by granulation tissue.

ıssage of a calculus down the ureter is accompanied by the
s known as **Renal Colic.** They consist of excruciating pain
ıxysmal nature, which comes on suddenly, and is referred
he loin and along the course of the genito-crural nerve. It
ı associated with vomiting and severe shock, the patient
ng on the floor writhing in agony, with cold perspiration
in beads on his forehead. The temperature is subnormal,
pulse weak and rapid. Strangury is usually present, the
ıffering from frequent paroxysmal efforts to pass water, but
eeding in evacuating a small amount, and that generally
ned. After lasting for a variable period, the pain suddenly
ı a result of the passage of the calculus into the bladder, or
ping back into the pelvis of the kidney.

lon in the Ureter may occur either just below the pelvis of
y, or near the brim of the pelvis, or near the vesical orifice.
ersons it has been detected on palpation through the ab-
vall, and when low down has been felt on rectal or vaginal
lon. Persistent pain and hæmaturia extending over days
should certainly suggest the presence of a ureteral calculus,
ıore so if with each succeeding attack the pain and tender-
located lower down. Radiography may confirm this by
ion of a shadow below the usual level of a renal calculus,
ly if the kidney is not specially enlarged. The result
ıat the stone will ulcerate through into the retro-peritoneal
d be discharged in an abscess; or more frequently the
disorganised, and perhaps the patient's life destroyed
he resulting renal incompetence.

ıs anuria is the term applied to a cessation of the urinary
which follows the blocking of one or both ureters with
.e opposite kidney in the former case being absent, atrophied,
ed. The condition is usually lighted up by some physical
hich presumably dislodges the calculus. It is ushered in by
pain in the loin, which often passes away in the course of two
days. The anuria is rarely complete at first, a few ounces
limpid urine being passed at intervals, whilst occasionally
polyuria is present. Sooner or later definite uræmic pheno-
pervene; the most usual period is seven or eight days after
it, but incomplete obstruction or a pre-existing condition of
phrosis may delay matters. The onset of uræmia is indicated
istent vomiting, a slow, full pulse becoming irregular, con-
of the pupils and muscular tremors. Coma and convulsions
ly seen, and there is no dyspnœa; the temperature is sub-

Diagnosis of renal calculus is often a matter of uncertainty in
nce of a history of the passage of gravel or of the occurrence
colic. It is most likely to be mistaken for tuberculous
; the differential diagnosis between the two conditions has
been considered (p. 1164). The final determination of the
ı or not of a renal or ureteral calculus is now usually made

ater ring. This box is placed on a platform on the sub-stage of couch, and by means of this sub-stage the box can be moved transversely.

Patient.—It is extremely important that the patient's bowels pty as possible when the skiagrams are taken, in order that no

SKIAGRAM OF CALCULUS IN URETER. (MR. A. D. REID.)

a young lady, and the diagnosis was confirmed by operation; was a rough concretion of acid phosphate of lime. (N.B.—The is calculus has been a little strengthened to ensure its satisduction. With one other exception (viz., Plate XXV.) it is the n which has been 'touched up' in the entire series published in

e thrown on the plate by fæcal material in the large intestine rpose the kidney shadow and be mistaken for a calculus. The is to keep the patient on light diet and a saline aperient for two taking the skiagrams. The night before a purgative is given grains each of Pulv. jalapæ and Pulv. scammonii, and on the na is administered through a long tube; no meal is allowed im is taken.

ent.—In the early stages treatment is directed to the cure
s (see p. 1195). The patient's diet and general habits of
be suitably regulated, and he is instructed to make use of
vaters, such as those derived from Contrexéville or Vichy,
of lithia and sulphate of soda may be administered in a
Plenty of bland fluid should be ordered, such as boiled or
vater, in the hope of dissolving the stone or assisting its
assage to the bladder. Sometimes it may become encysted,
tient is kept absolutely at rest; the symptoms will then
y ameliorate, and finally disappear.
ns of renal colic are treated by the use of hot hip-baths,
inks, and hypodermic injections of morphia; in the more
ses chloroform must be administered.
ner days, when the presence of a calculus could only be sus-
om the history or symptoms, the question of operation and
undertake it was a subject of much discussion. Even in
ys Mr. Henry Morris wrote that 'an unsuspected renal
is a source of very real danger; and when its presence is
l, whether by accident or by the systematic examination of
e, we should recommend its immediate removal, regardless
ct that it is not causing pain, unless the general condition
atient contra-indicates an operation.' At the present time,
diography has placed in our hands a means of almost certain
s, the same advice holds good—whenever a stone is found,
it, unless special contra-indications exist. Especially is this
when a considerable amount of blood or pus is being passed
rine, and the patient's temperature is raised. Pain in both
is no contra-indication to operation, since there is no objec-
xposing and even removing calculi from both organs. The
passage of gravel, moreover, need not deter one from
g, since when once the kidney has been relieved by removal
rger masses, the tendency to recurrence may be checked by
diet or drugs.
o-lithotomy is always undertaken through the loin. When
the kidney is carefully freed from its connections, and drawn
he wound; in the majority of patients it can be brought out
in, and this is certainly a desirable manœuvre. The whole
then carefully palpated, as also the pelvis and upper part of
r, so as to locate, if possible, the stone. Should it be dis-
lt within the kidney substance, an incision is made through
parenchyma over it; free hæmorrhage follows, but this is
ntrolled by inserting the finger into the wound, or by grasp-
essels in the hilum. Should the stone not be palpable, an
s made through the convex border of the kidney substance,
sterior to the mesial plane of the organ and at the junction
rior and middle thirds. One of the lower calyces is opened
eans, and the interior of the pelvis is carefully and fully
by finger and probe. Sometimes the incision in the kidney
considerably enlarged and the discovery of a small calculus

may be a task of great difficulty. When the pelvis is much distended and the patient has previously passed a good deal of pus, extra precautions must be taken to protect the surrounding tissues from infection. Sterile gauze is packed into the angles of the wound, and the assistant must press up the abdominal wall. The incision still passes through the cortex in preference to opening directly into the pelvis; a pelvic incision heals with difficulty, and is liable to leave a fistula. Stones are removed by dressing-forceps or scoop, and care must be exercised to prevent any from falling backwards into the ureter. Large branched calculi are often held very tightly, and require an extensive incision and careful peeling off of the kidney substance. The pelvic cavity need not be irrigated under ordinary circumstances, but when dilated and suppurating it is well to do so with a hot solution of sublimate or of Condy's fluid. Before closing the wound in the kidney the ureter should be carefully examined; it is sometimes possible to introduce a ureteral sound through the open wound, but this is by no means easy, and it is often wiser to make a tiny opening through the pelvic infundibulum, through which the sound is passed, and which is subsequently sutured by a Lembert's stitch. Bleeding is usually controlled without difficulty by sutures passed through the kidney substance, to which in bad cases may be superadded pressure by sponge or a gauze plug in the wound. It is useless to attempt to place a ligature on a vessel divided in the renal parenchyma. It is usually wise to introduce a drainage-tube down to the sutured wound in the kidney, after it has been replaced. The abdominal parietes may then be closed in the usual way.

A **ureteral calculus** may be reached by prolonging the lumbar incision downwards and forwards in a direction parallel with Poupart's ligament towards the inguinal canal (the lumbo-ilio-inguinal incision of Henry Morris). The peritoneum and its contents are pushed bodily inwards, and the ureter attached to the posterior peritoneal wall can be followed down to within a few inches of the bladder. A stone is removed through a longitudinal incision, which is subsequently closed by Lembert's stitches. A calculus impacted close to the bladder has been removed through the rectum or vagina, or by a trans-sacral operation.

Where the organ is totally disorganized nephrectomy may be required, but such treatment is not always advisable, especially when sinuses have resulted from a suppurative perinephritis. In such cases the renal tissue has often entirely disappeared, and disintegrating calculous material may occupy the pelvis, which is surrounded by a mass of dense fibro-cicatricial tissue, the removal of which is impracticable and even dangerous. All that should be attempted is the extraction of the stone and the purification of the cavity; the patient must resign himself to the inconvenience of a suppurating sinus in the loin.

Tumours of the Kidney.—The different forms of tumour which originate in the kidney may be classified as the *simple* and the *malignant*. Several cystic conditions also occur. The general features of an enlarged kidney have been already described (p. 1149).

ıple tumours of the kidney are :

ıe Cystic Disease (or, as it has been termed, adenoma of the vhich may be congenital or acquired. It is not unfre- llateral, especially when congenital. The kidney is en- l occupied by cysts, varying in size, but rarely exceeding herry; they are lined with epithelium, which is generally and filled with a limpid fluid containing urea and perhaps ıe. The cysts are often very numerous, and may project ırface of the kidney [illegible] elastic outgrowths. vis remains unaffected later stages of the ig. 428). Generally kidney is involved, attain enormous ; but occasionally h is limited to one f the organ. The this condition is un- ıt it is supposed to be e persistence of the os (or Wolffian body) bstance of the true metanephros), and ment into cysts. The ıptoms are simply ressure, but at a later secretion of urine is with to such an extent duce uræmia. The

FIG. 428.—CYSTIC DISEASE OF KIDNEY. (KING'S COLLEGE HOSPITAL MUSEUM.)

f this affection to affect both kidneys prevents any hope of m operation.

loma of the renal pelvis is a rare condition, characterized elopment within its cavity of a villous mass, identical in with that met with in the bladder. It has usually been ı elderly people, and the chief, if not the only, symptom is ıæmaturia. It cannot be diagnosed with certainty, but if ı exploratory operation, it can be removed with success.

ıionally tumours of a considerable size are found growing idney, similar in structure to the zona fasciculata of the xdies. They are looked on as **adenomata** growing from ınd misplaced adrenals; the renal parenchyma is normal though stretched over the new growth. They may remain time, but when once they begin to grow their increase in d, and they must be looked on as semi-malignant. When they may be removed together with the kidney, and the usually satisfactory.

ıt tumours of the kidney may be divided into :

larcomata of Infants, which are often congenital, but may

be acquired within the first few years of life. They are encapsuled, the kidney substance being sometimes spread over them, and consist of round or spindle cells, the latter often showing a cross-striation, resembling that of muscular fibres (myo-sarcomata). They grow to a great size, and may affect both organs, but pain and hæmaturia are absent. Death results from general dissemination or from exhaustion, or may follow mechanical obstruction to the circulation, as by the detachment of a sarcomatous embolus, which travels upwards and blocks the pulmonary vessels. **Treatment** by nephrectomy has given most unsatisfactory results, the operative mortality having been high and recurrence almost invariable within a short period. The operation itself is not particularly difficult, but a large incision is required, and care must be taken to avoid displaced structures, such as the inferior vena cava. When both kidneys are affected, nothing can be done.

2. The **Sarcomata of Adults** occur between the thirtieth and fiftieth years of life, and are of the spindle-celled variety. Only one kidney is generally involved, giving rise to a rapidly growing swelling, associated with pain and hæmaturia. Calculi are often found in the pelvis of such organs. Secondary deposits form in the viscera; extension through and beyond the capsule is not uncommon, and death is usually due to exhaustion. The results of nephrectomy have not been very encouraging.

3. **Carcinoma** is an uncommon form of tumour in the kidney. It presents the same clinical features as a sarcoma, and can only be recognised on microscopic examination. One symptom, however, requires special mention, since it is extremely suggestive of the presence of cancer, viz., the development of a varicocele. It is due to the pressure of enlarged and cancerous lymphatic glands upon the roots of the spermatic veins, and hence, whenever an elderly person develops a varicocele, a careful examination of the kidney on the affected side should always be instituted.

Various **Cystic Conditions** of the kidney must be noted in addition to the general cystic disease, already described.

(*a*) **Hydatid Disease** affects the kidney, as it may involve any other organ in the body. It starts either beneath the capsule or in the glandular substance; in the former case it is likely to form a rounded projection, which may be detected on palpation of the loin; in the latter it expands, or even destroys, the whole of the glandular tissue, and may burst into the renal pelvis, the cysts being passed along the ureter, accompanied by more or less colic. Suppuration may complicate matters, but, unless the cyst has ruptured into the pelvis, diagnosis is scarcely feasible apart from an exploratory incision.

Treatment consists in cutting down on the kidney, and enucleating the mass, if possible. Failing this, drainage may be undertaken, but n bad cases nephrectomy is necessary.

(*b*) **Dermoid Cysts** have also been found.

(*c*) **Serous Cysts** are occasionally met with, arising possibly as a result of obstruction to some of the ducts. Rounded swellings, single

ltiple, are produced, growing outwards from the cortex, and ining a thin fluid with a small amount of albumen and saline nces in solution. They give rise to no symptoms except from ize, and rarely require treatment other than simple aspiration inage.

Not unfrequently a number of small cysts develop in con- ı with chronic granular nephritis, but they are of no clinical ance.

hrectomy, or total removal of the kidney, is performed for the ng conditions: (*a*) For tuberculous disease, when conservative res are impracticable, or when the pelvis and ureter are in- ; (*b*) for calculous pyonephrosis, when the renal parenchyma ıtegrated; (*c*) for hydronephrosis, when palliative measures or ge have failed to give relief; (*d*) for malignant disease; (*e*) for ıtic lesions, such as disintegration or rupture, especially if cated by laceration of the peritoneum; and (*f*) for some cases ured ureter.

ıre undertaking the excision of any kidney, however diseased, sential that the surgeon should satisfy himself as to the exist- ' another, and also, if possible, ascertain that it is capable of aking the increased duties which will subsequently fall upon any different plans of doing this have been already alluded to o).

hrectomy may be undertaken through the abdomen or through n; but sundry combinations or modifications of these opera- ave been recommended by various authorities.

Abdominal Operation is chiefly utilized when the organ is much d, on account of the readier access obtained, especially to the . The main objection lies in the fact that the peritoneum is , and thereby exposed to septic contamination, especially he pelvis and the upper part of the ureter are distended with posing pus, as is frequently the case. Moreover, no satis- drainage is obtained for the cavity left by the removal of the unless a counter-opening is made through the loin. Of course, t advantage, as before stated, is that the other kidney can be xamined, and its condition ascertained. As to the technique: xposing the kidney in the manner already described, the organ d from its adhesions to surrounding tissues, the surgeon being l to keep outside its true capsule, but inside the layer of con- l perinephric tissue. Special precautions must be adopted in g with the posterior aspect of the tumour, particularly on the ide, where it is occasionally adherent to the inferior vena cava. ıass is now lifted from its bed, and its pedicle, consisting of the and renal vessels, isolated. These latter are secured separately ature and divided, a clamp being applied to the distal ends. ureter is dealt with in the same way, small pieces of sponge packed round so as to receive any secretion which may escape; posed mucous membrane in the portion which is left is care- ouched over with pure carbolic acid. The kidney thus freed is

removed, and the wound in the posterior parietal layer of the peritoneum brought together, if possible, by sutures, provision for drainage having been previously made either through the loin or by the insertion of a gauze drain from the front. The abdominal cavity is carefully cleansed from all blood-clot, and closed in the usual way. Considerable shock is always experienced from this operation, and the death-rate from this cause is somewhat high.

The *Lumbar Method* can only be employed when the kidney is not much enlarged. The organ is exposed by the incision already described, enucleated from its surroundings, and the pedicle dealt with as in the abdominal operation. If the condition of the opposite organ has not previously been ascertained, Kocher recommends that the peritoneum should be incised at the outer margin of the wound, so as to enable the hand to be inserted across the middle line, and thus allow an exploration of the opposite loin.

Should it be desirable to include the ureter in the scope of the operation, the incision may be prolonged into the groin in the direction of the fibres of the external oblique, and the peritoneum and its contents pushed forwards; by this means it can be traced down almost to the bladder.

CHAPTER XXXIX.

BLADDER AND PROSTATE.

Methods of Examining the Bladder.

a patient presents himself complaining of increased fre- of micturition and other evidences suggestive of chronic of the bladder, a systematic examination of the individual urinary passages must always be instituted. The history of , the character of the symptoms, and the condition of the e carefully gone into. At the first interview it is advisable ıe patient to void his urine, after which, providing no tight exists, a medium-sized catheter-à-boule, or one of rubber, e gently introduced, and the amount, if any, of the residual timated and tested. Having gained all the information from this source, an examination of the bladder should then , or perhaps at a subsequent visit. (1) The patient is laid ıch, and the lower part of the abdomen uncovered. The rium is then examined by inspection, palpation, and per- so as to ascertain whether or not the bladder is distended, abnormal resistance can be felt, either from thickening of or the presence of a tumour. (2) A sound is then passed ; to the method described at p. 1203, and the interior of the xplored; by this means a calculus may be detected, and metimes a tumour, as also a rough and irregular condition of cous membrane. (3) The finger is inserted into the rectum, he female, into the vagina, before the sound is withdrawn, so nable the condition of the posterior vesical wall to be investi- etween the point of the finger and the sound. Enlargement prostate or of the vesiculæ seminales can also be detected in ay. (4) As mentioned elsewhere, Bigelow's evacuator is not only to wash out the bladder, but also to detect the e of very small calculi which the sound may have missed. recent years a new means of examining the interior of the has been introduced in the shape of the *cystoscope* (Fig. 429). nsists of a straight tube with a short end bent at an angle, h an electric lamp is placed, the wires leading to it being within the tube. A small window covered with glass is close to the angle, and a prism is here inserted in such a

manner that, when the surgeon looks through an eyepiece placed at the end of the instrument, he is able to see the portion of the vesical wall illuminated by the electric lamp. To use it the bladder must be previously washed out, and the patient anæsthetized. About six ounces of boric acid lotion should be present in the bladder, so as to prevent the vesical wall from being injured by the instrument, which always becomes hot after the lamp has been used for some time. Different ends are supplied to enable the anterior and posterior walls to be examined. Considerable practice is needed for any useful information to be gained by the aid of this instrument, but in skilled hands much may be learnt as to the condition of the mucous membrane. (6) Finally, in cases where great irritability of the bladder exists in spite of treatment, and its presence cannot be

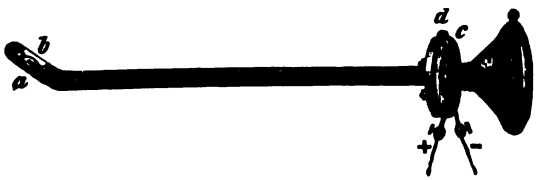


FIG. 429.—LEITER'S ELECTRIC CYSTOSCOPE. (TILLMANNS.)
a, Electric lamp in beak; *b*, glass window for illumination purposes; *c d*, switch for opening or closing current.

explained, an exploratory cystotomy, either supra-pubic or perineal, is justifiable.

A *distended bladder* constitutes a rounded swelling, which projects above the symphysis pubis, and may even reach to the umbilicus in some cases. The swelling may be visible to the naked eye, and is dull on percussion; it is quite immoveable, and therein differs from many ovarian and uterine tumours. Bimanual examination *per vaginam* or *per rectum* should at once indicate its nature; and when at all doubtful, a catheter should be introduced.

Congenital Affections of the Bladder.—1. **Ectopia Vesicæ, or Extroversion of the Bladder,** is the term given to denote total absence of the anterior wall of the bladder and of the lower portion of the abdominal parietes, as a result of which the mucous membrane of the posterior vesical wall is exposed and rendered somewhat prominent by the pressure from behind of the abdominal contents (Fig. 430, 1). This surface is usually not much more than an inch in diameter in an infant, and is often irregular, and covered with papilliform processes; the orifices of the ureters are easily recognised below, urine being occasionally emitted from them in forcible jets. The condition is necessarily one of the greatest discomfort, not only from the constant dribbling of urine causing excoriation and eczema of the thighs and surrounding parts, but also from the pain and irritation due to friction of the clothes against the exposed mucous membrane. The symphysis pubis is always absent, and the horizontal ramus of the pubic arch terminates on either side in the inguinal region (4). The innominate bones are usually rotated outwards, and the sacrum is convex anteriorly from side to side instead of being concave. In consequence of this pelvic malformation, the patient's gait and powers of progression are considerably impaired. The penis (2) is cleft, and in a condition of complete epispadias; it is drawn upwards and backwards over the trigone, so

equires pulling down to expose the ureteral orifices. The testes are ınd in the inguinal canal, or, if in the scrotum, are accompanied by al herniæ. No umbilicus is present. The condition is due to impaired ıent of the anterior wall of the allantois and the lower segment of the al parietes. At birth the lower portion of the umbilical cord is expanded raw surface, constituting the anterior vesical wall. When the cord ı, the posterior vesical wall is necessarily exposed.

reatment of this distressing malformation is most unsatisfactory. The of the cases are treated by the application of a urinal, but, unfortunately, ıments hitherto devised are not particularly efficient. Various operative ı have also been practised, with the object of covering the exposed ınd forming, if possible, a reservoir in which the urine may be retained.

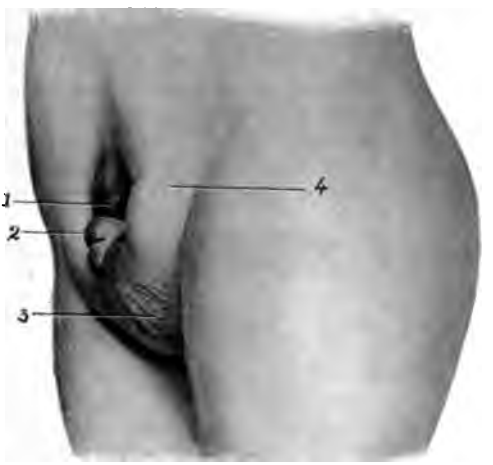


FIG. 430.—ECTOPIA VESICÆ.

:d mucous membrane of posterior wall of bladder; 2, glans penis, ı up to cover over lower part of vesical mucosa and orifices of the 's; 3, scrotum; 4, projection of pubic ramus.

ıelenburg's operation consists in division of the sacro-iliac ligaments ıind, so as to enable the lateral halves of the pelvis to be compressed ſ. By this means the posterior vesical wall is thrown backwards and its y to protrude lessened. The wounds are allowed to granulate, and, if ul, the bladder wall finally lies at the bottom of a sulcus, which can be covered over by a plastic operation without much difficulty. The jections to this method are that it involves a very severe operation, and ıds to a further weakening of the pelvic arch, the integrity of which is much impaired by the absence of the pubic symphysis. (*b*) Plastic ons without interfering with the pelvis have been introduced and prac- y the late Professor John Wood, Thiersch, and others. For full details, ıt refer to larger text-books. Suffice it here to state that a skin flap is down from the anterior abdominal wall above the breach of surface, and on either side to the margins of the defect. The cutaneous surface of ı constitutes the anterior wall of the newly-formed bladder, if such it can d, whilst its raw outer surface is covered in either by flaps derived from ide, or by undercutting the neighbouring skin and sliding it upwards middle line, where it is united by sutures, as suggested and successfully out by Mr. Boyce Barrow. The after-treatment is always prolonged and

need to be inserted for a few hours, so as to remove any
The abdominal wall is then closed in the usual way,
tient put back to bed. The urine is either drawn off at
ervals, or a catheter may be tied in the bladder, the urine
ıoned by an attached rubber tube into a vessel placed
.e bed.

eritoneal Rupture of the bladder involves its anterior wall
The urine finds its way into the pelvic cellular tissue, and,
thy, at once gives rise to a most virulent form of suppurative
llulitis, which is usually fatal from toxæmia or pyæmia.
s generally point either above the pelvic brim or in the
ı. The treatment consists in free incisions through the
ı, or above the brim of the pelvis. If the urine is healthy
ntaminated with bacteria, and is not allowed to remain long
t with the tissues, the prospects of recovery are good.

Bodies introduced into the bladder from without are of
ıatures, such as portions of catheters or bougies, pins, etc.
e rise to symptoms of chronic cystitis, and usually become
vith phosphatic deposit. They should be removed as early
le with a lithotrite, but if of large size or thickly covered
sphates, must be treated by perineal or suprapubic cystotomy.
male digital dilatation of the urethra is the best means of
ccess to the interior of the viscus.

s may be due to a great variety of causes, but is always in
f bacterial origin. Many different forms of bacteria may
but those most usually present are the ordinary pyogenic
ecially the *Staphylococcus aureus*, which, together with the
s *ureæ liquefaciens*, has the power of decomposing urea and
ee ammonia, whilst the *B. coli* is also commonly found
ases. This latter organism has no power of rendering the
aline, and hence if present in a pure infection the urine
cid, though stale and offensive to the smell. The *methods of*
the bladder are diverse: (1) Bacteria may reach the viscus
e, either owing to a suppurative lesion of the kidney or its
being filtered with the urine from the blood. (2) They
l up the urethra. This is a matter of no difficulty in the
l comparatively large urethra of a woman, and hence
frequently associated with vulvitis or is seen after labour.
pure bacillary cystitis with acid urine is not uncommon,
obably secondary to a vulvo-vaginitis, which arises from
ation of the vulva from the fæces where cleanliness is
. In the male sex, infection by the urethra is unusual
thritis has previously existed or some irritation, due to the
of instruments. Even if they are carefully sterilized,
liable to form and cling about the urethral wall, and along
ria can find their way. Naturally the introduction of an
d, dirty instrument may suffice to cause cystitis. The
s can necessarily extend backwards to the bladder, and
he most acute types of cystitis are due to this organism.

ergoes decomposition. Perforative ulceration occasionally iginating a fatal peritonitis or pelvic cellulitis from extra- of urine. The contracted state of the bladder and the h of its muscular substance lead to compression of the of the ureters, hydronephrosis being thus induced. A plug mucus often finds its way into the ureteral orifice, and by g infected with bacteria causes an extension of the septic to the kidney.

ymptoms of Acute Cystitis consist in pain referred to the n and hypogastrium, together with tenderness on pressure symphysis pubis. This is accompanied by extreme irrita- the bladder, frequent efforts of a painful and spasmodic eing made to pass water (strangury); but little urine is it a time, for as soon as any amount has collected it is orcibly. It generally contains blood and pus, soon becoming and teeming with bacteria. Some amount of fever is noted, as also vomiting, whilst tenesmus may be induced as of the proximity of the rectum to the inflamed bladder. al termination of the case is in resolution, but sometimes rritability may persist. In rare instances the inflammation h a virulent nature as to cause death. The urine in these often exceedingly foul, and the fatal issue is due to ex- , peritonitis, suppurative pyonephrosis, or even acute . In some patients, however, when the inflammation is ated at the neck of the bladder, retention, distension, and ay ensue.

ment.—The patient should be kept in a warm atmosphere, erably in bed, and fomentations applied to the lower part of men; hot hip-baths twice daily, maintained for some time, advantageous. The diet should be restricted to fluid, and nt encouraged to partake freely of barley-water and other quids. Alkalies and henbane may be administered, and and belladonna suppositories are useful to allay the pain and y. As a rule, no instrument should be passed during the ge, unless retention is present; but if the urine becomes , the bladder may be gently washed out, or even drainage of ler through the perineum may be necessary (see Perineal ay, p. 1185). In the worst cases urotropine (5 to 10 grains), to 20 grains), and boric acid (15 to 20 grains), administered outh, may do good.

ic Cystitis is much more common than the acute variety, and y associated with some irritation of the walls of the viscus, calculi, tumours, foreign bodies, tuberculous ulceration, or n and decomposition of urine, especially if associated with ion to the outflow, as by a stricture or enlarged prostate. It o follow acute cystitis.

ymptoms are those of irritability of the bladder, the patient ly desiring to pass water, and having to rise at night, perhaps times, for this purpose. The urine becomes turbid, and on deposits a variable amount of mucus or muco-pus, mixed

with epithelial cells, crystals of triple phosphate, and a granular sediment of phosphate of lime. It is usually alkaline, perhaps foul-smelling and ammoniacal, containing an abundance of micro-organisms. There is often but little pain, though when a calculus exists, or the neck of the bladder is ulcerated, this may become a prominent symptom. The patient's general health is not at first affected, but if the symptoms persist it soon becomes impaired, partly from the absorption of septic products from the bladder, and partly from the want of rest and sleep arising from nocturnal disturbance, and this may be so marked as to lead to fatal exhaustion. In other cases the inflammation may spread from the bladder along the ureters to the kidneys, and the phenomena of septic pyelonephritis manifest themselves (p. 1160).

The **Diagnosis** of chronic cystitis is readily made from the characteristic symptoms of irritation of the bladder and the condition of the urine; but considerable difficulty may be experienced in determining its cause. In investigating a case, not only must the character of its onset be considered, but also the general history of the patient, whilst a thorough examination of the lower urinary passages must be instituted, and the urine examined microscopically. The passage of a catheter or sound will generally detect any obstruction located in the urethra, whilst the bladder is also examined by the different methods described at p. 1177.

The **Treatment** of chronic cystitis is naturally directed towards its cause, if such can be discovered; thus, calculi or foreign bodies should be removed, and strictures dilated. In most cases, even where the cause is not apparent, great benefit will be derived from washing out the bladder.

The bladder is best irrigated by passing a soft rubber instrument, to the end of which is attached a portion of drainage-tube about 3 feet long, and beyond this a glass funnel, into which the material employed is poured. By raising the funnel the fluid runs into the bladder, whilst on depressing it below the bed or couch the fluid returns on the syphon principle. The patient's sensations must guide the surgeon as to how much fluid can be borne in any particular case. Various solutions are employed for this purpose, but perhaps the most useful are weak Condy's fluid, sanitas (1 in 10), boric acid (20 grains to 1 ounce), perchloride of mercury (1 in 2,000), or a neutral solution of quinine (2 grains to 1 ounce), and they may be used alternately with advantage. The frequency with which the injections are made must vary with the severity of the symptoms; it is not often necessary to perform the operation more than once or twice a day. Of course, the most stringent precautions must be taken as to sterilization of the patient's penis, of the surgeon's hands, and of the instruments employed.

At the same time that this local treatment is being adopted, the patient's general habits of life must be regulated. The diet should be bland and unstimulating: alcohol is better avoided, but if essential for other reasons, well-diluted gin or whisky may be given. Tea and

uld be prohibited, whilst milk should be given freely, together
ey-water and some mild alkaline water, such as that derived
trexéville. As to medicines, there are none which can alter
on of the urine from alkaline to acid, but perhaps salol, boric
benzoic acid may be of some assistance. Urotropine is
ting by setting free formalin in the bladder. Hot infusions
uva ursi, and triticum repens, act as mild diuretics, and as
s to the vesical mucous membrane; full doses, however,
a pint or a pint and a half in the course of the day, are
Where much muco-pus is excreted, copaiba, cubebs,
ne, or sandal-wood oil may be given, whilst injections of
stringents have been advised, but must be used with caution.
ases which do not improve, and if the patient is becoming
ed from the constant interference with his rest, etc., the only
of treatment left is that of opening the bladder through a
incision. **Perineal Cystotomy** is undertaken not only for the

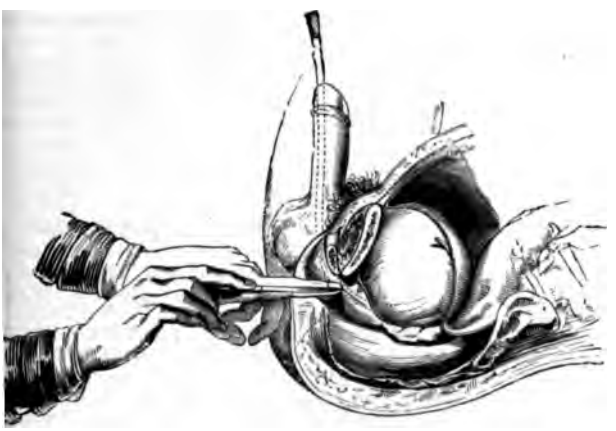


FIG. 431.—PERINEAL CYSTOTOMY. (FERGUSSON.)

of a chronically inflamed bladder, but also to explore the
lining of the viscus, to remove growths and foreign bodies,
ometimes to deal with prostatic enlargements and calculi.
lder is first thoroughly washed out, a few ounces of antiseptic
being left within it. After anæsthesia has been induced,
ith a median groove is passed into the bladder, and then the
s placed in the lithotomy position, and the perineum shaved.
on is made in the middle line of the perineum, from a point
s in front of the anus to about 1 inch from that opening.
e divides the deeper structures of the perineum, and, guided
ft index finger in the wound (Fig. 431), is made to enter the
a the staff at a point corresponding to the membranous
of the urethra. It is then carried upwards and backwards
he groove, incising the prostate and entering the bladder.

The knife is carefully withdrawn, the finger gently inserted into the bladder, and the staff removed. After digital exploration of the bladder, a full-sized gum-elastic catheter (No. 16 or 18) is passed in through the wound and fixed, a long piece of rubber tubing being attached to allow of the constant escape of the urine, as well as to permit of occasional irrigation. The catheter is removed and changed at the end of forty-eight hours, and in favourable cases may be discontinued altogether at the end of a week; in severer cases a permanent opening may have to be maintained.

Complications and Dangers of Perineal Cystotomy.—(1) *Hæmorrhage* may arise from three sources: the superficial arteries of the perineum, the deep branches of the pudic (especially that which passes to the bulb), and the veins of the prostatic plexus. The first of these are divided in the superficial incision, and may be readily secured, if necessary, by forceps and ligature. The artery to the bulb is not likely to be wounded if the incision is limited anteriorly according to the directions given above; if, however, this trunk or its branches in the bulb are cut, free arterial hæmorrhage follows, which is usually stopped without difficulty by opening up the wound and seizing the bleeding points with forceps. Venous hæmorrhage from the prostate is a more serious matter, and is especially prone to occur in elderly persons with prostatic hypertrophy. It is recognised by venous blood welling up from the depths of the wound, or possibly, if not evident at the time of the operation, by the bladder becoming distended with clot, considerable pain being thereby induced. If noticed during the operation, it is treated by syringing out the wound with iced lotion, and the insertion of an air tampon or a petticoated tube. The former contrivance consists of a gum-elastic catheter, the deep portion of which is surrounded by an indiarubber bag, which can be inflated with air through a small tube fitted with a stop-cock, to which a force-pump can be attached. The petticoated tube is used when the latter is not obtainable or fails to act; it is made by tying a petticoat of lint or gauze around the distal end of a vaginal tube; this is then passed into the bladder, and the space between the petticoat and the tube packed with gauze. If the bladder becomes filled with blood-clot, this must be broken up and removed by syringing with hot water through a large-eyed catheter, and the wound subsequently plugged around a catheter. (2) A *Wound of the Rectum* may be caused by carrying the incision too far backwards, or by not maintaining the point of the knife strictly in the groove; it is more liable to happen, however, whilst withdrawing the knife, the point being swept backwards, thus opening the bowel. It is often not recognised until flatus and fæces are passed through the wound at a later date. If of small size and situated low down, it will probably close by cicatrization without special treatment; but when high up and more extensive, a recto-vesical fistula is likely to follow. The treatment usually recommended in such a case is to divide the sphincter, and thus lay the lower end of the rectum and the cystotomy wound into one cavity, the communication being sometimes closed by the contraction of the granulation tissue which fills up the wound. In suitable cases it may be possible to stitch up the opening from the rectum after paring its edges. (3) *Pelvic Cellulitis* is caused by cutting beyond the limits of the prostate, and thus opening up the recto-vesical fascia, or by bruising and over-distension of the neck of the bladder by dragging through it too large a stone. In either case urinary extravasation and diffuse septic inflammation are likely to follow, resulting in grave constitutional disturbance of a septic nature, and possibly in the death of the patient. The treatment suggested is to support the general health by suitable diet and stimulants, whilst local tension is relieved by extending the wound backwards, even into the rectum. (4) An acute ascending pyelonephritis is occasionally lighted up, in spite of all precautions, and cannot be prevented. For symptoms, etc., see p. 1160.

Tuberculous Disease of the Bladder may be primary or secondary, the latter being the more usual and extending from the kidney.

r testicle. It is much more common in men than in d is most frequently seen in young adults. It commences mucous tissue as a deposit of miliary tubercle, which nd suppurates, breaking down, and giving rise to ulcers rmined edges; these are rarely of large size at first, are ltiple, and situated in or near the trigone. The **Symptoms** of chronic cystitis and hæmaturia, the irritability of the ig very marked. The diagnosis is made by demonstrating s of tubercle in the urine, and by the cystoscope. The the case is unfavourable, the ulcers increasing in size, and ulting from exhaustion, general infection, phthisis, or to the kidneys.

nt.—The case is usually treated for some time as one of stitis before its nature as a tuberculous affection is ascer- n the milder cases it may suffice to attend to the general l hygiene of the individual, and to wash out the bladder antiseptic two or three times a week, leaving a drachm or o per cent. solution of iodoform in olive oil or glycerine viscus. In more advanced cases cystotomy has been a by the suprapubic method, and the ulcerated surfaces nd disinfected by applying the galvano-cautery or pure id. To effect this the method suggested by Mr. Hurry of using a suitable speculum as a caisson through which especially to be recommended. It is doubtful, however, ich practice is of much ultimate value. When the primary kidney or testis is efficiently treated, a secondary bladder en improves.

milar **Symptoms** may be induced by the presence of a er of the Bladder, which, according to Fenwick, occurs not tly. It is usually single, and situated near the neck or ving rise to great irritability of the viscus and hæmaturia, the urine remains clear. The diagnosis is best made by scope. Phosphatic deposits sometimes form over the surface, and may suggest the existence of a stone. Treat- ists in washing out the bladder with lactic acid ($\frac{1}{2}$ to 3 per in scraping and cauterizing the base of the sore through a c incision.

s of the Bladder.—New growths from the vesical wall are ncommon; they may be simple or malignant.

Tumours occur in the form of fibroma and myxoma, but : often seen is the **Papillomatous** or **Villous Tumour**, which s a soft flocculent mass, usually situated near the trigone, to the opening of one of the ureters (Fig. 432). The ufts or villous processes consist of an extremely delicate e tissue, covered with a layer or two of epithelium similar ining the bladder, and traversed by bloodvessels. Occasion- rowths have a narrow base, and are pedunculated, but more are sessile. They may be single, or may multiply rapidly, d all over the bladder by infection from the primary growth.

The **Symptoms** are those of recurrent hæmorrhage, the blood being of a bright red colour, followed later on by irritability of the bladder. At first the hæmorrhage is intermittent, considerable intervals occurring between the attacks; but subsequently it becomes more continuous. The irritability of the bladder is generally induced by chronic cystitis, and when the urine has undergone alkaline changes, there is a copious exudation of ropy mucus, which, mixing with the urine, causes considerable difficulty in micturition, leading in some cases to strangury. On standing, this deposit becomes so tenacious

FIG. 432.—VILLOUS TUMOUR OF THE BLADDER. (FROM KING'S COLLEGE HOSPITAL MUSEUM.)

and jelly-like as to be poured with difficulty from one vessel to another. The urine may also contain portions of the tumour which have been set free, and occasionally, if situated near the neck of the bladder, some of the fimbriated ends may be swept into the urethral orifice, and interfere with micturition. In the same way the opening of one or both ureters may be encroached upon, leading to hydronephrosis. On examination of the bladder with a sound, nothing definite can be detected, unless the surface of the growth becomes encrusted with phosphates, and no abnormality is noticed on rectal

tion. Occasionally a small portion of the growth may be n the eye of a catheter.

rognosis of the case is unsatisfactory, since, although the is not at first malignant, it often becomes so, and leads to termination through exhaustion, hæmorrhage, or septic tions.

a of the bladder is an unusual disease, more often seen in than in adults. In the former it gives rise to multiple growths, in the latter it is usually single and sessile. The grows rapidly and may attain considerable dimensions,

—CANCER OF BLADDER. (ROYAL COLLEGE OF SURGEONS' MUSEUM.)

g outside the bladder and even invading the pelvic bones. tic glands are often implicated at an early date.

r of the bladder may originate in that viscus, or may spread n the rectum or neighbouring organs. In the former case, ous epithelioma is the usual type; in the latter, the nature rowth is, of course, similar to that of the primary disease; en secondary to rectal cancer, the tumour is of a columnar lost frequently the affection commences in the posterior wall e trigone, extending forwards to the neck of the bladder. wth is sometimes superficial, projecting into the vesical cavity t spongy mass, which does not ulcerate early, or invade the r walls till late; but more frequently the neoplasm ex- to and infiltrates the walls, whilst marked ulceration is also

ria always precede the bleeding for a considerable interval, finite evidence of the existence of the growth can usually out, both by the sound and on rectal examination. A worn usted appearance must not be looked on as necessarily the of advanced cancerous cachexia, since the loss of rest and to chronic vesical irritability can of itself lead to a some- ilar condition.

ent of Tumours of the Bladder.—In the early stages, when nosis of a tumour has not been confirmed, the hæmaturia reated with ordinary hæmostatic remedies, such as a mixture g dilute sulphuric acid and ergot, or turpentine administered es (10 minims three times a day). When once a diagnosis established, removal by operation is the only plan which any hope to the patient, and such can only be undertaken prospect of success in benign growths, or in the very earliest the superficial form of malignant disease. The bladder is either by perineal or suprapubic cystotomy, and the growth by the curette. The suprapubic operation is certainly pre- n that it gives one the opportunity of definitely seeing the of the bladder. The plan already mentioned of employing ding speculum as a caisson will be found useful; when all has been sponged away or sucked up, the vesical wall is the bottom of this tube by means of an electric lamp fitted rgeon's head. In default of a better instrument, a Fergus- culum can be utilized. Papillomata are removed, together mucous membrane from which they grow, by cutting round h the knife or scissors. Bleeding is stopped by pressure of or of strips of gauze soaked in adrenalin. The fingers of tant in the rectum will suffice to press up the posterior wall ive support. If possible, the incision in the mucous mem- ould be closed by stitches. Carcinomatous growths are uitable for removal, but possibly some benefit may be derived ing away the projecting part with a curette.

removal is impracticable, it only remains to ease the patient's s by means of morphia, the bladder also being occasionally out; but if the irritability is very great, a permanent supra- perineal opening may be established.

Functional Derangements of the Bladder.

inence of Urine.—A patient is said to be suffering from incon- when the urine escapes involuntarily, dribbling away either ly or intermittently from the urethra.

ive Incontinence is often present in young children, mostly t results from some condition of increased excitability of the apparatus, and is looked on by some as of a choreic nature; instances, it is probably due to weakness of the sphincter which is unable to resist the pressure induced by even a nount of urine. The chief sources of irritation are phimosis,

ıscarides in the rectum, a rectal polypus, or urine of high specific ;ravity, containing uric acid crystals in suspension. The affection is nost obvious at night, and, indeed, may only occur during sleep; it ıas been known to persist till adult life is reached. Somewhat similar ın nature to this is the irritability of the bladder induced by calculus, inflammation, or ulceration, where frequent calls to micturition are experienced; to this, however, the term 'irritability of the bladder' is applied, 'incontinence' being only used where no active disease of the viscus is present.

Treatment of the nocturnal incontinence consists in the removal of all sources of irritation, such as a tight foreskin, whilst the child is waked from sleep at regular intervals in order to pass water, so as to break him of the bad habit. Tonics, *e.g.*, iron, arsenic, and quinine, may be administered, and tincture of belladonna should also be given in full doses. Instruments have been used for compressing the urethra at night, and are stated in some cases to have effected a cure.

2. **Passive Incontinence** is said to be present when the neck of the bladder is relaxed, so that as soon as any urine is secreted, it flows out of the urethra, the bladder in this way never becoming distended. It arises mainly from two causes: (*a*) *Paralysis* of the sphincter vesicæ, as a result of some injury or disease of the spinal cord, which may impair its function either temporarily or permanently. Thus, in severe shock, the bladder is unconsciously evacuated from relaxation of the sphincter; but if the lumbar cord is not compressed or destroyed, the function is soon regained. Any lesion involving the centre for the sphincter necessarily destroys its future utility, and results in permanent incontinence. It is quite possible for the detrusor centre to be damaged without injury to the sphincter, and in such a case distension of the bladder with subsequent overflow supervenes. Paralytic incontinence occasionally follows overdistension of the female urethra for the removal of a calculus. Nothing can be done for either of these conditions, if permanent, beyond the application of a suitable urinal. (*b*) *Mechanical Incontinence* sometimes results from the impaction of a calculus in the internal meatus, or from its dilatation by a pedunculated growth from the prostate.

3. **False Incontinence**, or **Distension with Overflow**, is due to any condition in which the outflow of urine is impeded to such an extent as to lead to a certain quantity being left in the bladder after every act of micturition, although the patient imagines that the organ has been completely emptied. This so-called *residual urine* gradually increases in amount until the bladder becomes filled, and then some of it dribbles away involuntarily so as to wet the patient's clothes. In old-standing cases the bladder can be detected as a tense, rounded swelling in the hypogastrium. This condition is usually met with in patients with neglected stricture or enlargement of the prostate, and in the latter case the bladder may be so distended as to contain several pints of urine. Very much the same state of things obtains in paralysis due to spinal mischief. Treatment must be directed

; the bladder emptied by the regular use of the catheter, n remains in an atonic state for some time.

f the Bladder is the term applied to a condition in which t is unable to expel its contents, not in consequence of any ysis of the muscular walls, but simply from loss of tone. usual causes are: (1) Chronic overdistension, the result of a to the outflow, owing to enlarged prostate or stricture, scribed: (2) a single prolonged voluntary or involuntary sion; for instance, owing to the oversight of a house- patient suffering from retention after an operation for was left unrelieved for more than twenty-four hours, tony was induced. (3) It occasionally follows cystitis, that of gonorrhœal origin. (4) In old age atony is due to simple loss of nerve tone, a condition very similar ich occurs after or in the course of infective fevers, such as d is even met with after influenza.

lighter cases all that is noticed is some hesitation or diffi- mmencing the act of micturition, whilst the flow of urine nd cannot be efficiently completed, a few drops dribbling rwards. In worse cases a considerable amount of residual be left in the bladder, and this may lead to chronic dis- ith overflow, and by its decomposition to chronic cystitis. cases actual retention may be induced. The **Treatment** directed to removing any source of obstruction which hilst regular catheterism two or three times a day will ny distension of the bladder, and the administration of s, phosphoric acid, and other tonics, will improve the power of the viscus. The passage of a constant current ity may also be employed two or three times a week, to the muscular fibres; one electrode is inserted into the nd the other placed over the hypogastrium.

on of Urine.—When a person is unable to expel the con- he bladder, so that it becomes distended, retention is said sent. It results from a variety of conditions, classified as (1) *Penile and urethral* causes, *e.g.*, phimosis, or congenital of the urethra, a ligature or ring placed around the penis, calculus, the so-called congestive or spasmodic stricture, ricture, urethral or perineal abscess, ruptured urethra, etc.: *tic* causes, *e.g.*, inflammation, abscess, tumour, hyper- alculus: (3) *Vesical* causes, *e.g.*, atony, paralysis, calculus, etc.: (4) *Reflex* irritation, such as occurs after operations tum and anus, or involving the spermatic cord: (5) *Hys- Pressure* from neighbouring organs or external tumours, ne fibroids or retroversion of the gravid uterus. In investi- y particular case, the age and condition of the patient must nto consideration, and also the character of any preceding ymptoms, whilst a careful examination should be made. generally, one may state that the most common cause of in infants is phimosis; in children, impacted calculus, or a

ligature around the penis; in young men, gonorrhœa or one of its complications; in young women, hysteria, or foreign bodies in the bladder; in adult men, stricture; in adult women, some uterine condition; and in old men, hypertrophy of the prostate.

If left unrelieved, the urine accumulates and the bladder becomes distended, giving rise to much pain and discomfort. One of two conditions is certain to follow: (*a*) In cases of retention from stricture the dilated urethra behind the seat of obstruction gives way, resulting in extravasation of urine. If, however, the bladder wall is weakened by the presence of sacculation, rupture of a saccule may follow, causing pelvic extravasation. (*b*) When the retention arises from atony or paralysis, or from some obstruction which can be to some extent overcome, distension with overflow is produced.

Inasmuch as retention is merely a symptom, the **treatment** necessarily varies with the cause.

Abnormal Conditions of the Urine.

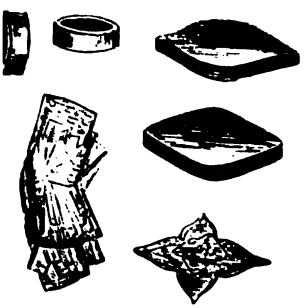
1. **Urinary Deposits.**—*Uric* or *lithic acid* is eliminated in the form of 'cayenne-pepper' granules, usually known as gravel. On microscopic examination, the granules are found to consist of flat rhomboidal, lozenge-shaped plates, or masses of acicular crystals (Fig. 434). They are of a dusky brownish-red colour, due to the absorption of urobilin, the normal pigment of the urine. The secretion in these cases is always acid, and usually of high specific gravity. The deposit is not soluble in boiling water, but readily so in alkaline fluids; and on reacidulating such a solution, the uric acid is precipitated in the shape of white needle-shaped crystals.

Urates or *lithates* of potassium, sodium, or ammonium are of frequent occurrence in the urine, appearing as a deposit of amorphous granules of variable colour, according to the amount of urinary pigment present, and this is often known as a 'lateritious,' or brick-dust sediment. The ammonium salt is sometimes found in the shape of spiculated globular bodies (Fig. 435). Urates always occur in acid urine of high specific gravity, and are freely soluble in boiling water; on the addition of dilute hydrochloric acid the uric acid is precipitated. The *murexide* test may be applied for either uric acid or its salts; it consists in mixing the substance to be tested with a little nitric acid, and evaporating to dryness, when an orange-red discoloration is produced, which on the addition of liquor ammoniæ changes to a deep purple-red.

A deposit of uric acid or urates is either a temporary condition dependent on some trivial derangement of the system, or a phenomenon constantly recurring and due to too great an indulgence in nitrogenous food, too little fresh air and exercise, or imperfect digestion, the result of some hepatic disturbance. It is also noted in conditions where great tissue change is occurring, as after violent exercise or in fevers. Under these circumstances the materials which should be changed into urea are transformed into uric acid or its salts.

ch a tendency is continually present, the patient is often e suffering from **Lithiasis** or **Lithæmia**. Should the indi- r incapable of eliminating the material thus formed, an gout is likely to supervene, whilst it must always be borne hat the formation of a uric acid calculus is merely a mani- of the same diathesis, which needs careful treatment after al of the stone, if a recurrence of this painful affection is vented.

eatment of lithæmia or lithiasis consists mainly in attention sonal hygiene. The patient's diet is regulated, all sweets, d alcoholic stimulants (with the exception, perhaps, of a ky well diluted with lithia or potash water) being avoided. abits are enforced, and plenty of outdoor exercise recom- The hepatic secretion is stimulated, and the bowels regu-



4.—Uric Acid Crystals.

Fig. 435.—Urate of Ammonium in Amorphous Granules and Hedgehog-shaped Bodies.

the administration of saline purgatives, especially natural waters, *e.g.*, Friedrichshall, Carlsbad, or Hunyadi Janos, occasional dose of blue pill or podophyllin is advisable. lts and piperazine have also been employed with advantage.

of lime usually occurs in the urine of dyspeptic and hypo- al patients, who are pale, nervous, and irritable. It is sup- arise from the incomplete oxidation of carbohydrate foods. is of low specific gravity, pale and abundant in quantity, tly acid in reaction; an excess of mucus is usually present, he crystals to adhere to any irregularities in a test-glass. scopic examination they are found to be regular octahedra, shape of dumb-bells (Fig. 436). The *treatment* of oxaluria a regulation of the diet, which must be light and nourishing, food being avoided, as also rhubarb, which contains large s of oxalates, and the patient is directed to drink only boiled d water. Tonics, such as mineral acids, iron, and quinine, rdered, but the best treatment consists in change of air and if possible, from causes of anxiety and worry.

ic deposits in the urine occur in three forms: (i.) The triple , or ammonio-magnesic, is found in alkaline or decom-

posing urine, and is always vesical in origin. It exists in the form of hexagonal prisms, three of the sides, however, being very narrow; the ends also are bevelled off, so that the appearance of a 'knife-rest' is produced (Fig. 437). (ii.) The amorphous phosphate of lime is exceedingly common, forming the main mass of any phosphatic sediment. It is always present in chronic cystitis, and is not unfrequently met with a few hours after a meal, constituting what is known as the 'alkaline tide.' This condition is often observed about twelve o'clock in the morning, especially if an alkaline saline purgative has been taken before breakfast. The phosphatic material is voided at the end of the act of micturition, and may give rise to considerable anxiety on the part of the patient, who mistakes it for seminal fluid. (iii.) The most usual condition in which phosphates are met with in urine is a mixture of the two varieties described above. Whichever form is present, the deposit becomes more evident on boiling, disappearing, however, on the addition of a few drops of acid. The treatment of

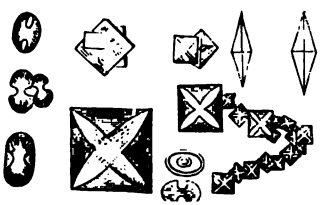


FIG. 436.—OXALATE OF LIME IN OCTAHEDRAL CRYSTALS AND DUMB-BELL-SHAPED MASSES.

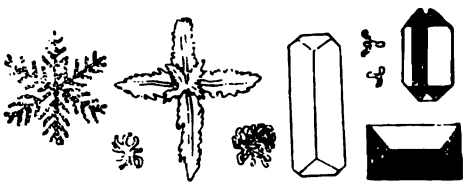


FIG. 437.—CRYSTALS OF TRIPLE PHOSPHATE IN URINE.

phosphaturia is always directed to the vesical condition, except in those unusual cases where it is due to some constitutional error.

2. **Hæmaturia**, or the admixture of blood with the urine, is best described according to the source from which the blood is derived.

(*a*) *Renal* hæmaturia results from acute inflammation, congestion, calculus, tumours, or injuries of the kidney. The urine is sometimes deeply coloured with the blood, and may be as dark as porter. Blood casts of the renal tubules are often observed, and even long sinuous clots, corresponding to the shape of the ureter.

(*b*) *Vesical* hæmaturia is due to injury, calculus, tumours, ulceration, simple congestion of the bladder with varicosity of the vesical veins, or the presence of the *Bilharzia hæmatobia*. The blood is intimately mixed with the urine, but is more abundant at the end of micturition, and clots are often present.

The *Bilharzia* is a parasite which inhabits some of the rivers and pools of South Africa. It is taken into the system by the mouth, and may develop either in the urinary track, or sometimes in the lower bowel (p. 1124). The adult worms are found in the body inhabiting the radicals of the portal and vesical veins, and discharge their ova through the mucous membrane of the bowel or bladder, giving rise to hæmorrhage. By an extension to the kidney, pyonephrosis may

l. No specific treatment has at present been discovered, st cases the disease after a time disappears spontaneously.
atic hæmaturia may be caused by congestion, calculus, , or malignant disease; the blood passes back into the nd hence the phenomena simulate the vesical condition. ion of the prostate from the rectum may, however, give a e source of the mischief.
thral hæmaturia arises from acute gonorrhœa, laceration, or ntation. The blood often flows from the urethra indepen- f micturition, whilst the first few drops of the stream are ured.
ematuria is occasionally of *constitutional* origin, arising from · scurvy, or hæmophilia; other manifestations of these will be observed, and render the diagnosis evident.
icopical examination of the urine should always be made to whether or not blood corpuscles are present, since the con- ay be simulated by that known as 'paroxysmal hæmoglobin- hich corpuscles are absent. The latter condition is supposed to vaso-motor spasm of the renal arterioles, and is not un- ly associated with Raynaud's disease.
nly certain test for the presence of blood is by spectrum ; but that most usually relied on consists in mixing together rts of tincture of guaiacum and ozonic ether. The suspected ubsequently added, and sinks to the bottom of the test-glass; precipitate forms at the line of junction of the two fluids, standing becomes a bright blue colour if blood is present.
ivestigation of a case of hæmaturia in order to ascertain its ould be conducted in the following way: (*a*) The history of nt and of his urinary trouble should be taken. (*b*) The : of the urine should be investigated, noting its colour, and or not the blood is intimately mixed with it. (*c*) The relation ssage of the blood to the act of micturition should be noted g the patient pass the first and last portions of the urine rate vessels from that in which he passes the bulk; if the all three vessels is equally discoloured, the hæmorrhage omes from the kidneys; if most of the blood is in the first comes from the urethra or prostate, whilst if the bulk of it ed in the last vessel, it is probably derived from the bladder.
scopical examination of the urine may lead to the discovery of tumour, epithelial cells, or blood-casts, which could be ived from some special part of the urinary track. By these e source of the hæmorrhage, whether from kidney, bladder, or urethra, may be detected, and an opinion formed as to e of the disease.
ria is the term applied to the admixture of pus or muco-pus urine. It always results from inflammatory affections of the membrane lining the urinary passages, and may be renal, prostatic, or urethral in origin; the methods of investigation, to ascertain its exact source, are the same as for hæmaturia.

urine is mainly recognised by the microscope, whilst on the
of liquor potassæ it becomes ropy.
luria, arises from distension or rupture of the lymphatic
n the vesical mucous membrane, and is usually due to the
of the *Filaria sanguinis hominis* (p. 361). The urine is milky
r, and on microscopical examination this is found to be due
resence of an emulsion of fat.
lbuminuria, or the escape of some of the albuminous contents
lood with the urine, is a condition of such frequent occurrence,
important in its results, that the precaution should always be
d of testing the urine of every patient before undertaking any
tive proceedings; and this is the more essential because it is
nown that this condition often exists quite unexpectedly and
ly apart from symptoms.
sts.—Many different methods have been adopted for detecting
resence of albuminuria. The following are, however, the chief:
On simply boiling the urine a milky white deposit forms, similar
nat which is caused by an excess of phosphates; the latter, how-
r, disappears entirely on the addition of a single drop of dilute
tic acid, whilst the former persists. (2) Nitric acid gives a white
ud or light-brown flocculent precipitate. The urine should first
boiled, and the acid added, but not in excess, as the deposit may
re-dissolved. A more delicate test consists in pouring the cold
ine into a test-tube, and carefully adding the acid, so as to form a
ratum below the urine; at the line of junction of the two, a white
lm is formed, if albumen is present. (3) With picric acid a yellow-
sh-white precipitate is thrown down, increased by boiling. If the
rine is neutral or alkaline, it must first be rendered slightly acid by
he addition of a few drops of acetic acid.

When once the existence of albumen in the urine has been ascer-
tained, its source and its significance must be investigated. A
careful microscopical examination of the sediment is made, so as to
determine whether casts or pus cells are present. The condition of
the peripheral bloodvessels in the limbs and the character of the
pulse should be noted, as also the previous history of the patient.

Albuminuria arises from a variety of sources, and its significance
necessarily turns on the origin of the affection. (1) When it occurs
in the course of some disease involving long-standing suppuration,
such as septic affections of bones or joints, it is probably due to
lardaceous change in the kidneys. If the urine is of low specific
gravity and light in colour, and with but few casts, only an early
stage of the condition is present, and conservative measures directed
to the treatment of the primary lesion will probably suffice; if, how-
ever, the urine is scanty and of high specific gravity with much
albumen and many casts, the affection has probably progressed some
way, and radical treatment, such as amputation, should be undertaken
to save the patient's life. The surgeon must be careful to prevent
any undue absorption of carbolic acid in the operation, as thereby
acute nephritis may be lighted up, and even a fatal issue determined.

a may be intermittent, and is then due to some tem-
al disturbance; this can only be ascertained by testing
time to time. In such cases operation is not contra-
lbumen usually disappearing with rest and careful
n caused by chronic Bright's disease, the concurrent
that affection will also be present in the shape of
ies and high pulse tension, whilst possibly a certain
rca may be noted, or the history of such at an earlier
is but little albumen, and a fair amount of urea is
t is possible by rest and suitable diet so to diminish it
he performance of slight operations; but where the
all advanced, all *opérations de complaisance* are absolutely
d, and only the chief surgical emergencies should be
t with, viz., hæmorrhage, asphyxia, intestinal obstruc-
lation, and retention of urine. In cases of severe in-
ion is generally indicated under circumstances where
ndividual conservative measures would be adopted.
malignant disease may be undertaken at the express
tient, if the increased risks associated with it have
to him. The importance of not operating on these
ls on the facts that they tolerate an anæsthetic badly,
are in a condition of lowered vitality, and hence the
ir is hindered, septic inflammations and erysipelas are
velop, whilst secondary hæmorrhage is likely to follow,
h pulse tension. Again, boils and carbuncles are very
se patients, and where such conditions are met with,
if they recur, the urine should always be examined.
ia may arise by extension of inflammation to the
surgical affections of the lower urinary organs, and
from shock or suppression of urine may follow an
r these conditions. (5) It is occasionally the result
se, owing to valvular incompetence and regurgitation
ic veins, and it is then advisable to delay all operative
digitalis has been administered in sufficient doses to
gent symptoms.

—The presence of sugar in the urine is also a matter
t importance from a surgical standpoint, and its
t should always be carefully ascertained. The chief
l are as follows: (1) Equal parts of liquor potassæ
f copper sulphate are boiled together, and then a few
spected urine added; if sugar is present, a yellowish-
forms by the reduction of the cupric salt to cuprous
e same result follows the use of Fehling's solution.
keep the copper solution separate from the potash;
them are boiled together, and a few drops of the urine
r is present, a red deposit occurs. (3) Picric acid and
are mixed and boiled, and the urine added; the
ugar is indicated by the solution turning to a dark,
olour. The admixture of 2 grains of sugar to the

ounce is sufficient to determine this discoloration to such an extent as to render the fluid quite opaque.

The effect of diabetes is very similar to that of albuminuria, in that it leads to diminished vitality of the tissues, and consequently predisposes to the occurrence of sepsis, and of such infective inflammations as boils and carbuncles. Peripheral neuritis and sclerosis of the smaller vessels are also induced by this disease in the later stages, and hence gangrene of the extremities is likely to occur, especially in chronic cases and in elderly people. The essential cause of trouble, however, is sepsis, and hence if the most rigid aseptic precautions are taken there is no reason why operative proceedings should not be undertaken in conditions of danger and urgency. Thus several cases have been reported lately in which such serious proceedings as total removal of the breast and axillary

A B

FIG. 438. — URIC ACID CALCULUS.

A, External aspect; B, on section.

contents for scirrhus, or appendectomy, have been safely undertaken in confirmed diabetics.

Stone in the Bladder.

Varieties.—A vesical calculus may be formed of almost any of the urinary deposits commonly met with, and each has its own special characteristics.

(*a*) The *uric acid* calculus (Fig. 438) is usually an oval, flattened body of considerable density, with a smooth or slightly nodular surface, and of a nut-brown colour. On section it is distinctly laminated, and it may be surrounded by a crust of phosphatic material.

(*b*) The *urate of ammonium* calculus is of very similar structure, but of a lighter colour, and the lamination is less distinct.

(*c*) The *oxalate of lime* or mulberry calculus (Fig. 439) is a rough, irregular body, sometimes evenly nodular, but not unfrequently tuberculated, or even spiculated. It is extremely hard and dense, laminated, and of a dark red-brown colour, or sometimes black, owing

e with blood. It is rarely of great size, on account of the used by its presence, and its slowness of growth.
e *phosphatic* calculus is very uncommon, but any stone or y is certain to become coated with a phosphatic deposit ic cystitis has resulted in alkaline decomposition of the asionally concretions of a similar nature form sponta- accules of the bladder; such bodies are white and chalky ce, friable in consistency, with no evidence, or but little, n, and on removal are exceedingly offensive. These con- sist of a mixture of the triple phosphate and phosphate ess commonly an excess of the triple phosphate is present; oportion of two parts of the latter to one of phosphate of inated and somewhat denser calculus is produced, which es termed a *fusible calculus*, owing to the fact that it fuses

A B

FIG. 439.—OXALATE OF LIME CALCULUS.
A, External aspect; B, on section.

under the blowpipe flame. Occasionally a phosphate of us occurs in the upper urinary passages, *e.g.*, the pelvis of and has a crystalline appearance on drying.
e forms the basis of a rare calculus which is of a yellowish- r and waxy appearance.
hine, or xanthic oxide, occurs very exceptionally as a a reddish colour.
ted calculus is one which develops in a pocket or pouch with the bladder wall. It may consist of any of the above , and is due to a small stone finding its way into a l being arrested there. It grows by gradual accretion of ous material, and after a time projects into the vesical typical illustration is shown in Fig. 440, where the large l portion is separated from the encysted part by a narrow asionally this condition is due to the decomposition of ine in a pouch, and the calculus is then phosphatic in ; it is not unlikely to lead to ulceration of the sac wall sation of urine.

Structure of a Calculus.—A calculus usually consists of the following parts: 1. The *nucleus*, which may be formed by a portion of blood-clot, inspissated mucus, a renal calculus, or some foreign substance introduced from without. 2. The *body*, which consists of superposed layers of uric acid or oxalate of lime, or of whatever substance the stone is composed; not unfrequently the composition of adjacent laminæ differs, leading to what is known as an *alternating calculus*. Each lamina consists of myriads of minute crystals, held together by vesical mucus, with which a certain amount of phosphatic material is often mixed, whilst layers of pure phosphatic deposit may be interposed. 3. The *crust* consists of a variable amount of soft, friable phosphatic material, the quantity of which is the measure of the degree of chronic cystitis originated by the calculus; in some cases it is entirely absent.

FIG. 440. — ENCYSTED VESICAL CALCULUS REMOVED BY SUPRAPUBIC LITHOTOMY.

The **Number** of calculi present in a bladder varies greatly. Sometimes there is only one; occasionally a considerable number, counted perhaps by hundreds, may exist; in such circumstances they are never of great size. Multiple calculi are not unfrequently faceted as a result of mutual friction.

The **Causes** of vesical calculus must be looked for in some of those constitutional conditions already described as predisposing to lithiasis or oxaluria. They are very common in children during the first decade of life, especially amongst the lower classes, the children of the rich rarely suffering from stone. It diminishes in frequency from childhood to the age of twenty-five, and then gradually increases until it is relatively common in elderly men. The condition is comparatively rare in women, owing to the fact that the shortness and large size of the urethra allow small calculi to be much more readily passed. Possibly the character of the drinking-water, or the amount imbibed, is a matter of importance, as indicated by the fact that the occurrence of calculus is very unequally distributed in different parts of the country; thus, it is most frequently met with in the Eastern Counties. It is also very common in India and Arabia, a fact which may possibly be explained by the large amount of fluid withdrawn from the body by perspiration.

Symptoms.—The effects produced by vesical calculi vary in different individuals, according to the shape of the stone, and the tolerance of the mucous membrane. In children and young adults, where the parts are very sensitive, even a smooth calculus gives rise to severe symptoms, whilst old men often tolerate a large stone without much inconvenience; *cæteris paribus*, an oxalate of lime

always more irritating than one composed of uric acid.
:al symptoms of a vesical calculus may be preceded by a
the patient having passed 'gravel' for a long time, or by
of renal colic, on the cessation of which the calculous
commenced. Sometimes the vesical symptoms do not
some time after the passage of a stone into the bladder,
/ in consequence of its small size. They consist of
perineum and neck of the bladder, which radiates to the
down the thighs, but is especially noticed at the end of
mmediately after micturition. The stone is then pressed
nst the sensitive neck of the bladder by the contraction
scular walls. Increased frequency of micturition is also
nd perhaps hæmaturia of a vesical type, though this is not
nt feature. All these phenomena are increased in severity
jumping, or any form of exercise, and hence are more
uring the day than at night. Occasionally the patient
that the flow of urine suddenly ceases before the bladder
:ompletely emptied, and that some change in the position
ly is needed in order to allow him to complete the act.
n to these characteristic symptoms, he may suffer from
henomena secondary to the irritability of the bladder, and
on the straining induced by the calculus. Thus, tenesmus,
)y piles or prolapsus ani, may be produced by sympathetic
of the rectum, especially in children; whilst a hernia
)e caused, and not unfrequently priapism.
nptoms are somewhat modified in *children*, leading to irrita-
ie bladder, as evidenced by wetting of their clothes and of
at night, and pulling at the prepuce and penis. These
ions are very similar to those caused by a tight foreskin,
h condition, indeed, a stone is often associated; hence, it is
always to sound the bladder of a child after circumcision
sis.

:ual **Diagnosis** of vesical calculus can only be made by
In order to accomplish this, the patient is laid on a couch
head low, and the buttocks raised on a pillow placed
iem. The bladder should always contain a few ounces
o as to obliterate any folds produced by laxity of the
nembrane, as well as to facilitate the introduction of
ment; the usual antiseptic precautions as to surgeon's
tient's penis, instrument and lubricating material, are, of
idly enforced. A sterilized sound of suitable size, warmed
ated by some antiseptic oil or ointment, is then gently
ng the urethra, and the handle depressed between the
legs so as to enable the point to enter the bladder. The
iich should be cylindrical in shape and fluted, with the
ame or some mark to indicate the direction of the beak, is
y grasped between the index finger and thumb, and rotated
to side, whilst at the same time the whole instrument is
wards or backwards in the urethra. Each side of the

bladder is thus carefully investigated, and, finally, if no stone is detected, the beak is turned directly downwards, so as to examine the pouch which often forms behind a slightly enlarged prostate. The presence of a stone is recognised by a metallic click, which can be felt and even heard, when the end of the instrument taps it. The character of the click is some guide to the size and density of the stone. The presence of two or more calculi is indicated by the surgeon being able to touch them on rotating the instrument alternately to each side of the middle line, or by seizing one stone with a lithotrite, and using it as a sound for the other. In doubtful cases, a still more delicate test than the sound is obtained by passing a medium-sized tube of a Bigelow's evacuator, and washing out the bladder. The calculi may by this means be washed out even from sacculi, and be felt to rattle against the end of the instrument when the pressure upon the indiarubber bulb is relaxed. When the calculi are multiple and of small size, they may be even removed in this way by an examination which was only intended to be diagnostic in character. The surgeon must not forget that a hypertrophied bladder with projecting fasciculi may somewhat resemble a calculus, especially when coated with phosphatic material. In some rare instances a calculus may be so completely hidden in one of the saccules as to render its detection impossible by these means. An encysted calculus which projects into the bladder is recognised by being always found at the same place.

Course of the Case.—A patient suffering from vesical calculus is certain, sooner or later, to develop symptoms of chronic cystitis, and septic changes in the urine are equally sure to follow—possibly as a natural sequence, but often as the result of the introduction of septic instruments. The bladder is hypertrophied, and if the stone is not removed, the mucous membrane becomes ulcerated, and the inflammation extends to the kidneys; the patient's life is thus destroyed, partly by exhaustion, and partly by septic or uræmic poisoning.

The **Treatment** of vesical calculus is a matter which has exercised the judgment and manipulative dexterity of surgeons for many generations. A large number of operations have been made use of, but at the present day only three are employed, viz., lithotrity, suprapubic cystotomy, and very uncommonly perineal cystotomy.

Lithotrity was formerly conducted at several sittings, the stone being crushed, and the patient allowed to pass the débris subsequently; this process was repeated at intervals of a few days, until the bladder was clear. Such a proceeding took a considerable time, and was exceedingly painful, irksome, and dangerous to the patient. The introduction of Bigelow's evacuator completely revolutionized this operation, and enables it to be completed at one sitting, constituting the proceeding sometimes termed Litholapaxy.

Operation.—The patient is carefully prepared by keeping him under observation for a few days, regulating the bowels, and, if possible, reducing any inflammation of the bladder by suitable diet and drugs, and by washing it out. On the preceding night a dose of

ninistered, and an efficient enema a few hours before
The patient should be warmly clad, and the legs
ck worsted stockings reaching nearly to the groins.
a has been induced, the head is kept low, and a pillow
the buttocks, so as slightly to raise
he bladder is carefully washed out
id antiseptic, such as a solution of
about 6 ounces of lotion are left
der not only to obliterate all folds
mbrane, but also to facilitate the
tone, and to prevent injury of the
e operation.
e is then introduced. The best
mploy is Thompson's modification
g. 441), the male blade of which is
female fenestrated. Other forms
ised in which the female blade is
ther the same size or larger than
rder to protect the walls of the
jury. The male blade slides easily
groove in the stem of the female
r the stone has been seized the
ibly pressed together by a screw
into play by the mechanism in
ch can be put in and out of gear
bsolutely essential that the instru-
made of well-tempered steel, so as
risk of breaking during the opera-
luce it some skill is needed, since
l is short, and consequently the
well depressed between the legs,
he beak may pass under the pubic
ition of the stone is next ascer-
ng the instrument, and using it as
blades are opened, and the stone
between them by a slight jerk of
This is better than attempting to
culus by inverting the blades, and
injure the mucous membrane. If
he blades when screwed up crush
fragments, each of which is sub-
with in a similar fashion. If only
the stone is gripped, the applica-
essure may cause it to slip away,
rre must then be carefully repeated.
son is satisfied that the fragments
small, the largest evacuator-tube
ely introduced is passed into the bladder. To effect
imes necessary to incise the urethral orifice with a

FIG. 441.—THOMPSON'S MODIFICATION OF CIVIALE'S LITHOTRITE. (DOWN BROTHERS.)

bistoury in a downward direction. The evacuator is attached to the tube, and the bladder thoroughly washed out by alternate pressure upon, and relaxation of, the rubber bottle (Fig. 442). By this means the fragments of the stone are collected in the glass receptacle which forms part of the apparatus. The washing is continued until no more fragments are heard or felt to rattle against the end of the tube. It is often necessary to reintroduce the lithotrite in order to crush some larger portions of the calculus still remaining; the old practice of withdrawing small fragments within the grasp of a lithotrite is to be condemned. It is scarcely necessary to re-sound the bladder after the efficient use of the evacuator. A certain amount of bleeding is indispensable from these manipulations, but it is not excessive in careful hands. Should, however, considerable

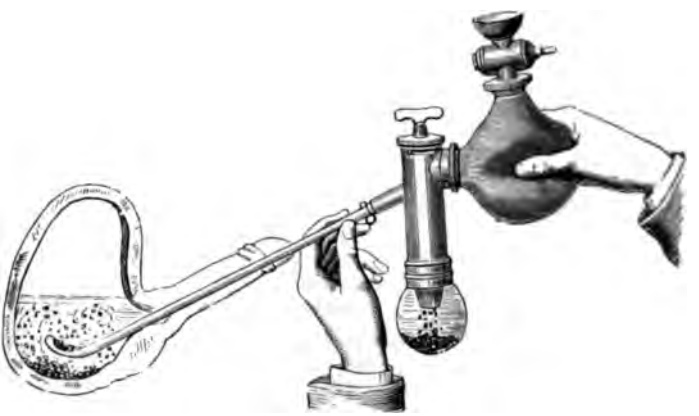


FIG. 442.—EVACUATOR IN POSITION IN THE BLADDER.

bleeding follow, the bladder is likely to become subsequently distended with clots, necessitating the use of a large-eyed catheter for their removal.

After-Treatment.—The patient is placed in bed as soon as the operation is completed, and kept warm and quiet, and suitable measures must be taken to combat shock. The diet is restricted to fluids for a few days, whilst pain, if complained of, may be relieved by a little morphia. If all goes well, he may be allowed to get up at the end of the week.

Various **Sequelæ** may follow this operation. *Cystitis* results partly from mechanical causes, but more frequently from imperfect asepsis. The symptoms are usually subacute in character, and may pass away after a few days; but if of a serious type, considerable constitutional disturbance arises, and a large amount of viscid muco-pus is excreted, whilst the urine becomes alkaline and ammoniacal. In such a case it is absolutely essential to wash out the bladder once or twice a day, as if left to itself the condition is very liable to spread up to the ureters, and may destroy the patient's life by suppurative pyelone-

my of the bladder is occasionally induced, either by the by a consequent cystitis, and is especially common in viduals. It must be treated by regular and aseptic

When the patient's kidneys are already affected prior tion, an acute ascending pyelonephritis (p. 1160) may be y it, perhaps leading to suppression of urine and death

Lithotomy was formerly looked on as a serious pro- a high mortality; at the present time increasing as shown that the dangers were preventable, and that onsidered a very successful procedure. The bladder is , and 8 or 10 ounces of lotion left within it; the patient ed in the Trendelenburg position, with the pelvis raised the head, the intestines being thus allowed to gravitate tero-superior part of the abdomen; as soon as the parietes are opened, air finds its way into the connective nd the symphysis (cavum Retzii), and the peritoneum is d back.

—The pubes having been previously shaved, and the am purified, an incision is made in the median line om the top of the symphysis upwards for about 2 or he lower part of the linea alba is divided, and the retro- ar tissue opened up. The tense rounded outline of the now be readily detected with the finger, and a couple of sutures or slings are passed through its walls so as to d prevent its subsequent retraction. An opening is then it in the middle line from below upwards, through which nger is passed and the stone examined. Suitably curved orceps are introduced, and the stone grasped and with- careful examination of the interior of the bladder is then scertain whether any further calculi are present, as also te the condition of the prostate, which may sometimes be emoved at the same time. The after-treatment of the rs with the condition of the bladder; if it is septic, a good- age-tube is introduced, and the urine syphoned off, healing by granulation in three to six weeks. If the bladder is d free from sepsis, it may be closed by sutures, which through the muscular and submucous coats, and thus lo not project into its cavity. The external wound may t open or closed, except at the spot where a drainage-tube ick is passed down to the vesical wound, so as to allow urine which may accidentally leak into the wound. The her drawn off by a catheter at regular intervals, certainly an three or four times daily, or the bladder is drained by catheter.

Lithotomy is seldom required at the present day; the described as perineal cystotomy (p. 1185) would be The finger is passed into the bladder, and the stone lt is removed by suitable stone forceps (Fig. 444), or by

a scoop and the finger (Fig. 443). Care must be exercised not to damage the structures at the neck of the bladder, or pelvic cellulitis may ensue; but this danger is little likely to arise, as the operation ought never to be undertaken when the stone is of large size.

Formerly much importance was attached to the operation of *lateral lithotomy*, in which the stone was removed through a perineal incision which included the left lateral lobe of the prostate. This

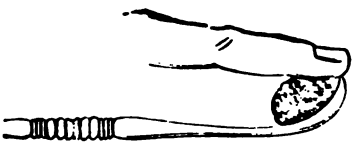


FIG. 443.—LITHOTOMY SCOOP, AND POSITION OF FINGER IN EXTRACTING STONE.

procedure is now entirely superseded, and need no longer be described.

Choice of Operation for Vesical Calculus.—At the present day lithotrity has been brought to such a standard of excellence that there is no doubt as to the general rule which should be followed, viz., that *unless some contra-indication is present, all cases of vesical calculus should be treated by lithotrity.*

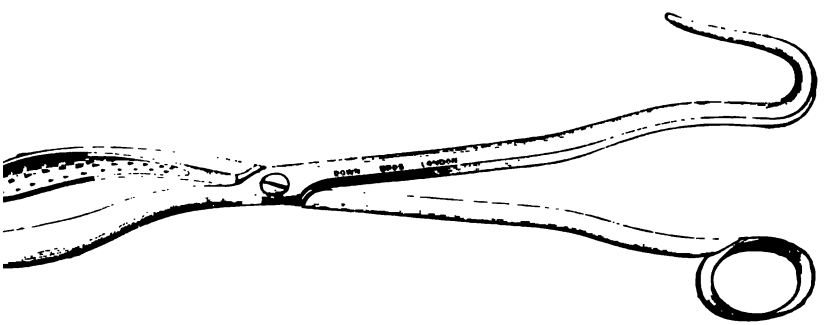


FIG. 444.—FORCEPS USED IN PERINEAL LITHOTOMY. (DOWN BROTHERS.)

The **Contra-indications to Lithotrity** are as follow: (1) *Conditions of the Stone.* If the calculus exceeds 1½ inches in diameter, it is not advisable to attempt lithotrity, on account of the damage which may be inflicted on the vesical wall. Moreover, some stones, especially those consisting of oxalate of lime, are so hard that no lithotrite can crush them. Phosphatic concretions, on the other hand, are so soft that a lithotrite becomes clogged, and crushing is impracticable. An encysted stone will also preclude lithotrity on account of its fixed position. There is no objection to dealing with multiple calculi by this means, but if only of small size, they may be removed by simply using the evacuator. (2) *Conditions of the Urethra.* The existence of an organic stricture, or an enlarged prostate, may

ıotrity impracticable from the impossibility of passing ugh instruments, whilst false passages may make it y difficult. Excessive irritability of the urethra, as by the occurrence of severe rigors after instrumentation, render the operation unadvisable. (3) *Conditions of the* The existence of severe cystitis or the presence of sacculi, d by the cystoscope, will usually suggest the performance ıy; whilst a contracted bladder, which will only hold a .s of urine, materially increases the dangers and difficulties ıty.

ıubic Lithotomy should be undertaken under the following ıs: (1) Where the stone is too large to be dealt with by ; (2) where the stone is encysted; (3) where a stricture or prostate is present, and it is often feasible to remove the at the same time. Suprapubic cystotomy is only absolutely ıdicated by two conditions, viz., severe septic cystitis and on of the bladder.

tions for Perineal Lithotomy.—(1) Where serious cystitis ıt irritability of the bladder are present, the incision ıg the process of draining and washing it out; (2) a con- ınd hypertrophied condition of the bladder; (3) when a is impacted in the neck of the bladder.

ıs in Boys is a common occurrence. It must be remembered bladder is rather an abdominal than a pelvic organ in and hence suprapubic lithotomy is particularly indicated. een shown, however, that lithotrity can be safely practised that suitable instruments are employed, and the external ; incised.

ıs in the Female.—As already mentioned, vesical calculus is ; amongst women, owing to the shortness and greater size rethra, so that small stones passing downwards from the re easily voided. Phosphatic concretions are not uncommon, hen formed around a foreign body usually introduced by the Many of the symptoms are very similar to those in the

reatment.—If the calculus does not exceed ½ to ¾ inch in , it can usually be extracted by dilating the urethra with r, the sphincter being also nicked in two or three places if r. It is never wise to divide the sphincter totally, as incon- s almost certain to follow. For a somewhat larger stone can be undertaken, whilst for those of really large size ic cystotomy is the best procedure. It has been recom- o open the bladder through the anterior vaginal wall, and ove a stone; but this is scarcely desirable, for fear of the ıce of a vesico-vaginal fistula.

Affections of the Prostate.

Prostatitis arises most usually as a sequela of gonorrhœa, its acute or chronic stage, by direct extension backwards

of the inflammatory process; it is also occasionally met with as a result of stricture arising from the irritation of retained and decomposing urine, or from the passage of instruments. It is also said to be induced by the application of cold or damp to the perineum, as by sitting on cold stones or damp grass, but probably this has been preceded by bacterial invasion of the posterior part of the urethra. Suppuration follows in not a few cases, being due to the infection of the prostatic follicles with pyogenic organisms. Sometimes merely one or two superficial follicles are affected, causing what is termed a *follicular abscess;* occasionally the mischief extends much more widely, involving the whole of one lobe, or perhaps the whole organ, and constituting a *parenchymatous abscess.*

The **Symptoms** consist of deep-seated pain referred to the neck of the bladder, with perhaps a sense of weight and fulness about the perineum. Micturition becomes frequent and painful, and defæcation may cause considerable distress. As the organ increases in size, the pain becomes more and more severe, and all movements of the body, as also the act of sitting, are increasingly difficult. On rectal examination the organ can be felt enlarged, hot, and tender. Suppuration is likely to follow, and retention of urine may be thereby induced. A follicular abscess bursts into the urethra spontaneously, or is ruptured by the passage of a catheter for the relief of retention; the opening, however, is sometimes of a valvular nature, and only a small portion of the pus escapes. The process may then continue to spread, and the pus may find its way into the rectum, or come to the surface through the perineum. In either of the latter conditions a rectal or perineal fistula is liable to result. Considerable constitutional disturbance is usually associated with this affection, whether suppuration occurs or not. The formation of a parenchymatous abscess is always attended with much more acute symptoms, both general and local. The organ is larger and produces more rectal irritation; a considerable quantity of pus may form, and suppuration may extend beyond the capsule into surrounding parts.

Treatment.—The patient should be kept in bed on a restricted diet, and the bowels freely opened by saline purges, combined with small doses of antimony, and perhaps full doses of hyoscyamus. Local depletion may be undertaken by cupping the perineum, or by applying ten or twelve leeches to it. Hot hip-baths are also very valuable, and linseed-meal poultices may be placed on the perineum after the leeches have been removed. Extreme pain should be relieved by the use of morphia suppositories, and if the urine needs to be drawn off, a soft rubber catheter of small size should be used. If an abscess forms and is not opened by the passage of a catheter, or if the natural opening is of a valvular character, so that the cavity cannot completely empty itself, an incision must be made into it through the middle line of the perineum, being guided by a finger placed in the rectum; pus may not be reached until the knife has entered to a depth of about 2 inches. Urine will sometimes escape from this opening, and may continue to do so for some considerable

gonorrhœa is also present, suitable treatment must be order to check the discharge.

Prostatitis is perhaps one of the most common causes of et after gonorrhœa. It is sometimes left as a sequela of tack, or may arise as a result of stricture.

ptoms produced by it are a sense of weight and fulness perineum, combined with irritability of the bladder, and ed to the extremity of the penis at the end of micturition, ne bladder contracting upon the hyperæmic and sensitive glairy discharge of viscid material, similar in appearance white of egg (*prostatorrhœa*), is often present, whilst fine mucus are usually seen floating in the urine, being due to on of mucous casts of the prostatic ducts. On examina- h the rectum, the organ can be felt enlarged and tender, siculæ are usually in the same condition. Chronic sup- ay follow, the abscess bursting into the urethra or rectum, in the perineum.

gnosis from tuberculous disease can usually be made by ntion to the history and physical signs.

nt consists in counter-irritation of the surface of the as by blisters or iodine paint, care being taken that the ployed does not extend either to the anus or scrotum. suppositories may be of value, whilst the occasional a cold metal bougie may do good. In suitable cases, ng-standing gleet is present with no suspicion of suppura- may occasionally be brought about by the administration f potassium, or of the liq. ferri perchloridi (♏xv. or more, bined with sulphate of magnesia. The local application on of nitrate of silver by a porte-caustique is also some- mmended, but we are not much in favour of such a Probably the best treatment consists in forcible dilata- prostatic urethra, as suggested by Oberländer, the follicles by emptied of their secretion; massage of the prostate against a sound held in position may also be useful. abscess form, it is incised through the perineum.

ous Disease of the Prostate is usually met with as a result on from similar disease in the epididymis, the seminal ing also invaded; occasionally, however, it may arise as a fection. In either case, it rapidly spreads to the bladder, to the ureters and kidneys. The prostate is found to eous masses in the early stages, but later on these break ing to extensive ulceration, and sometimes the organ is h ragged cavities. The symptoms are those of irritability of the bladder, combined with pain referred, perhaps, to the penis, or mainly noticed in the back or perineum. is occasionally produced, whilst pyuria is almost constant. is feebly acid or neutral, and, on examination of the pus posited on standing, the tubercle bacillus may be detected.

observed in these adenomata. Occasionally a few fibro-
may develop, but they are decidedly uncommon.
nges induced in connection with an enlarged prostate are
and important.*
prostatic sheath of pelvic fascia becomes thickened and
, thereby preventing any downward expansion of the organ,
ing its enlargement upwards.
close connection between the capsule and the sheath,
o marked a feature in the normal anatomy of the organ,
dly modified, so that it becomes easy to enucleate the gland
ety from its surroundings.
relations to the bladder wall are also much altered.
the sphincter (Fig. 445, S.V.) is interposed between the

445.

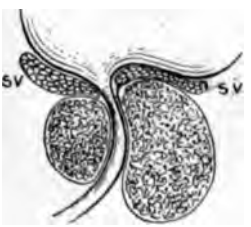


FIG. 446.

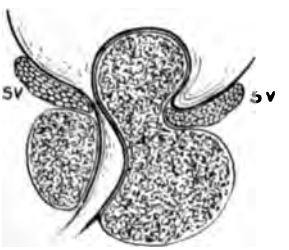


FIG. 447.

TO ILLUSTRATE RELATION OF THE PROSTATE TO THE SPHINCTER VESICÆ (S.V.)

the prostate is supposed to be of normal size, and the sphincter lies
t; in Fig. 446 the prostate is enlarged, but has no intra-vesical pro-
or 'middle lobe,' and hence the sphincter retains its normal relation;
447, the most common type of prostatic enlargement, a well-marked
sical projection or middle lobe exists, the sphincter being displaced
rds by this development.

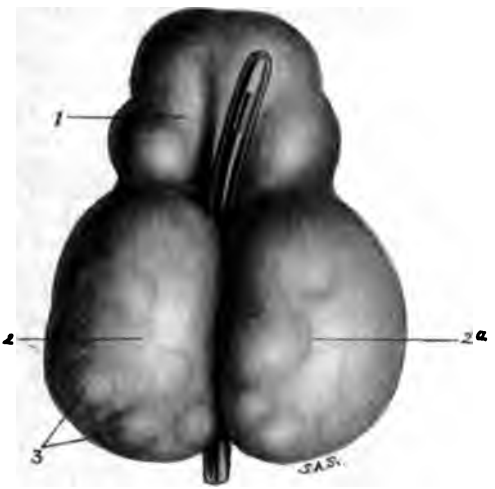
nd the vesical mucosa. As the gland enlarges, this relation
st (Fig. 446), and although the bladder base is raised up,
h is extra-vesical, and the sphincter muscle covers over
ement. More frequently, however, the gland, as it enlarges,
itself between the sphincter and internal meatus, con-
n intra-vesical enlargement (Fig. 447). This is generally
ked in the middle line behind, constituting the so-called
be'† (Fig. 448); but it may involve the whole gland, which
to the bladder as a collar-like enlargement around the meatus,
metimes one or both of the lateral lobes are chiefly affected
anner. The gland also pushes backwards between the

*he Surgical Anatomy of the Normal and Enlarged Prostate,' by
son Walker, *Med. Chir Trans.*, vol. lxxxvii.
† must remember that in the normal prostate there is no middle lobe,
structure thus named is caused by an abnormal overgrowth or pro-
one of the lateral lobes.

increased. Asymmetrical enlargement, of course, displaces
a to one or other side.

effect of an enlarged prostate *on the bladder* is important.
uction to the outflow of urine leads to increased expulsive
its part, and consequently the wall becomes thickened and
hied. This involves the muscular fibres, which stand out
tly as rounded fasciculi, and the mucous membrane may
ıtwards between them as hernial protrusions, constituting
in which urine may stagnate and decompose, and even
c concretions form.

/e already alluded to the fact that in almost every case the
ɔrostate projects more or less into the vesical cavity, either
r-like mass around the internal meatus, or as one or more



ı.—Enlarged Prostate after Removal by Suprapubic Operation.

ıeter indicates the position of the urethra. 1, The so-called middle lobe, ıtra-vesical projection behind the internal meatus; 2 and 2^a, the lateral s; 3, indicates the nodular adenomatous masses which constitute the : of the swelling.

l outgrowths. This is necessarily associated with a pouching ırds of the lowest part of the bladder (*prostatic pouch*), which, elow the level of the meatus, does not become emptied during tural process of micturition, and in which *residual urine* is re able to collect and remain.

itis is very likely to follow, either by infection from within or ıe use of unsterilized instruments, and then the bladder wall ıs inflamed; ammoniacal decomposition of the urine follows, ıal complications may ensue (either hydronephrosis or pyo- ıis), which will determine a fatal issue.

Symptoms vary somewhat with the nature and position of the

enlargement. The patient at first finds some difficulty in micturition, especially at the commencement of the act; straining often hinders rather than assists. The stream is not necessarily smaller than formerly, but is projected with less force. Gradually irritability of the bladder ensues, and the patient has to pass water very frequently, a trouble especially noticed during the night. Some degree of pain and a sense of weight and fulness about the perineum are also experienced, whilst tenesmus, and even hernia, may be subsequently induced by the straining. Intermittent attacks of increased pain and difficulty in micturition occur from time to time, being generally induced by exposure to cold and wet, and presumably due to congestion of the prostate. After lasting for a few days the more acute symptoms slowly disappear, if judiciously treated.

As the obstruction increases, a certain amount of residual urine remains within the bladder after each act of micturition, the vesical muscles in time losing power and becoming atonic. Well-marked distension and atony of the bladder ensue at length in neglected cases, the urine dribbling away and wetting the clothes, whilst decomposition of the retained fluid follows, and causes cystitis with increasing vesical irritation and muscular spasm. The urine becomes alkaline after a time, containing muco-pus and phosphates, the result of chronic cystitis. This, if untreated, is certain to lead to hydronephrosis and pyelonephritis. The general health of the patient is slowly undermined by the constant irritation produced by this process, as also by septic absorption, and the final chapter may be ushered in by symptoms of uræmia from the mischief inflicted on the kidneys.

Occasionally the early symptoms may pass unnoticed for a considerable time, the patient imagining that the frequent calls to pass water are good signs rather than evidences of disease. In such cases the bladder may become over-distended, and the condition unsuspected until, owing possibly to some exposure to cold or over-indulgence in alcohol, complete retention is induced, and then, to the surprise of the patient, an enormous amount of urine is withdrawn on the passage of a catheter. Priapism is sometimes a troublesome condition, and the effect of this on the moral sense may be very serious, and leads in some cases to acts of gross indecency.

The **Diagnosis** of enlarged prostate is made partly by a consideration of the symptoms complained of, but mainly by an examination of the urethra and rectum. The age of the patient, the increasing irritability of the bladder by night and day, the fact that straining hinders rather than helps the expulsive act, together with evidence of vesical distension—all these facts indicate that the seat of obstruction lies in the prostate. A rectal examination is then instituted, and some idea gained of the size and condition of the organ; it must not be forgotten, however, that the size, as recognised by a finger in the rectum, cannot measure in any way the amount of obstruction to the passage of the urine, and, in fact, it often happens that where the gland does not feel especially large from the rectum, the obstruction is the greatest. The careful introduction of a catheter will assist in

e diagnosis, inasmuch as the barrier at the neck of the easily detected, and sometimes with difficulty passed.

nt.—All that is required at first is regular catheterism, in event the bladder from becoming over-distended, and this may often be taught to do for himself. To pass a catheter f enlarged prostate is not always easy, owing to the fact iddle lobe (Fig. 447) projects across the urethra, and bars l progress of an instrument of the ordinary shape. The ıould therefore use either a catheter coudé or bicoudé which consists of a soft, straight instrument of the usual ɔe, the end of which is bent or doubly bent at an angle, so e it to ride over the obstruction; or he may employ an ım-elastic catheter, the stilette of which is drawn out a to increase its curve; or he may utilize the silver prostatic hich is longer and more curved than usual, depressing it ɛn the thighs after clearing the pubic arch. Whichever adopted, no force is required, since with a little skill the

FIG. 450.—CATHETER COUDÉ AND BICOUDÉ.

he instrument will pass round the obstruction and enter the Every precaution must be taken to ensure the efficient ɔn of all instruments employed, and it should be remembered general rule large rather than small instruments will pass ly.

the first fortnight of catheter life the patient must be care- rded from cold and exposure, to avoid the occurrence of ɔnal disturbance. Not unfrequently a certain amount of which the name of **Catheter Fever** was given by the late w Clark) is produced, which either passes off in the course days, or may increase, together with symptoms of chronic ınning on to a fatal issue at the end of three or four weeks. n of this condition is still somewhat doubtful; it may arise from the absorption of micro-organisms or their from the urethra, or from the use of impure instruments, ly reflex nervous disturbance plays some part in its pro- The only treatment required in the simpler cases is to keep it warm in bed, to limit his diet, to administer quinine and d to keep the bowels well open.

the continuance of catheter life, the patient must be warned ietly, and abstain from all excesses, especially as regards l drinking; sexual excitement should be avoided, and horse- orbidden; precautions must also be taken to ensure pro- m cold and damp. The administration of alkalies is desirable

ther side is desirable. The portion of the prostate pro-
the bladder is now carefully examined and its removal
l. The index and middle fingers of the left hand (which
with a sterilized indiarubber glove) are introduced into
so as to steady and push forwards the prostate. The
finger tears through the mucous membrane behind the
median lobe or collar, thus passing between it and the
phincter vesicæ. It will be found quite an easy matter
finger round the enlarged organ and enucleate it; the
prostate, the more easily this is effected. In this pro-
ejaculatory ducts are torn across, as also the vessels
r and leave the gland on either side. The urethra is
ved entirely, or the lower portion of it is detached and
The prostate when free in its sheath remains either in
r not unfrequently separates into two halves, which can
ff the urethra and removed separately from the bladder.
cy must be mentioned, viz., that of dividing the mucous
over the median lobe with scissors, and thereby open-
ine of cleavage which runs inside the capsule between
denomatous masses, which are thereby alone enucleated,
being left behind. A complete prostatectomy should
capsule and the many fragments of glandular tissue
rein.
cleation is attended by remarkably little bleeding in the
cases, and even when at all free it can be quickly re-
irrigating the cavity and bladder with hot saline solution
catheter. A rubber tube is passed into the bladder
lower angle of the wound, the upper end of which is
eep sutures, and provision is made for syphoning off the
gh the tube. Morphia is often needed subsequently to
pain and spasm that supervene, and it is advisably given
itory or as a starch and laudanum enema. The bladder
daily through a soft catheter passed *per urethram*, and
hs will escape for some days. As soon as the suprapubic
rotected by a layer of granulations, the tube should be
and a catheter tied in through the urethra. The patient
ip in an armchair as soon as possible to avoid pulmonary
ns. Not unfrequently he will commence to pass urine
about a fortnight or three weeks, and subsequently the
ll be maintained in a normal fashion.

al Prostatectomy a median staff is passed, and then the
s urethra and apex of the prostate are exposed, either by
osterior or transverse incision in the perineum. The
th of the prostate is torn through or divided by the knife,
ation is then carried out by the finger, assistance being
pressing the bladder downwards from above the pubes.
d that the urethra is less damaged in this procedure, but
ges of the operation are not apparent to us.
tient refuses these operations, or if his general condition

prevents them from being undertaken with safety, and catheterism is insufficient to give relief to his symptoms, a *permanent fistula* either above the pubes or through the perineum must be established, necessitating the use of a portable urinal. This is effected by introducing a trocar and cannula into the bladder, and leaving it there until a sufficient track has been formed.

Cancer of the Prostate occurs in elderly men, but is not common; it is usually of a scirrhous type, though sometimes it is of a soft nature; in either form it early progresses beyond the limits of the capsule. The symptoms produced are those of obstruction to the flow of urine, together with pain, which may be very severe, and at a later date hæmorrhage. The progress of the disease is much more rapid than in senile hypertrophy. On rectal examination the hard mass is readily detected, whilst secondary deposits may be found in the lumbar and abdominal glands on palpating the abdomen. Occasionally phenomena referable to pressure on the abdominal vessels and nerves arise, and the symptoms of general cachexia soon manifest themselves. Palliative treatment alone can be adopted.

CHAPTER XL.

AFFECTIONS OF THE URETHRA AND PENIS.

Affections of the Urethra.

tal Malformations.—Total Absence, or **Occlusion**, of the urethra
ı met with, the urine under such circumstances being some-
tained, and leading to dilatation of the bladder, ureters, and
, a condition rapidly fatal, even if the child be born alive.
· cases the urachus remains patent, and a congenital urinary
s established at the umbilicus, whilst in others the cloacal
n persists, the urine passing into the rectum.

adias is a deformity in which the urethra is partially or wholly
d along the upper surface of the penis. According to Mr.
r Morris, it is not, properly speaking, a division or deficiency in
per wall of the urethra, but in its floor, which has been trans-
to the dorsum by torsion of the penis. 'It is thus, in fact, a
padias reversed, *i.e.*, upside down.' In rare instances, the ex-
meatus is situated just above the glans, which is cleft and
grooved superiorly. More commonly the urethra opens at the
f the penis, just in front of the symphysis, and in such patients
an is always rudimentary and stunted. Complete epispadias
y present when associated with extroversion of the bladder
78). The incomplete form has been treated with success by
e of reversed flaps dissected up from the side of the penis. For
of the operations on this and the following conditions, see
text-books on operative surgery.

ospadias, or defective development of the lower wall of the
ı, is a much more common malformation than the foregoing.
varieties are described. In (*a*) *hypospadia glandis* the opening
urethra corresponds to the position usually occupied by the
n, and is thus directed downwards instead of forwards. The
e in these cases is always voluminous, and hangs like a hood
ıe glans, which is bent down over the orifice. (*b*) *Hypospadia*
characterized by the urethra opening somewhere along the
surface of the body of the penis, which is often small and
l. Considerable discomfort may arise in the act of micturition
to the urethral orifice looking downwards; it is also some-
o small as to require incision and dilatation. (*c*) Complete

d, bleeding points are secured, and if the ends of the
ın be identified, a soft catheter is introduced into the
nd they are sutured together around it with fine catgut.
: ends are much torn, it is wise to cut away the bruised
s so as to have clean, smooth surfaces to deal with. Under
ıstances the catheter must be kept in for five or six days,
', and subsequently an instrument should be passed every
me time.

ıeter cannot be introduced, or if extravasation has occurred,
)ns must be made into the scrotum and perineum to give
ɜ blood and urine, and to expose the seat of injury. A
, passed as far as possible, and its point felt for, cut down
ıided into the bladder; a prolonged attempt under anæs-
r be necessary to accomplish this, and even then it is use-
ɜmpt to stitch up the urethra, as the sutures are certain to
Occasionally, and especially if treatment has been delayed,
ng of the parts is so great as to render the passage of a
npossible. The patient must then be put to bed for a few
the blood-clot has disappeared, the urine in the meantime
hrough the perineal wound; but as soon as possible another
ust be made. When once the catheter is passed, it must be
)r several days, so as to establish the continuity of the tube.

. **Bodies** are sometimes found in the urethra, usually con-
ί a portion of a catheter, pipe-stem, or in children a piece of
ıcil. Their presence gives rise to partial or complete obstruc-
ıe flow of urine, followed by ulceration of the mucous mem-
e formation of a peri-urethral abscess, or even extravasation.
) readily detected on the passage of a sound or catheter, and
removed by suitable forceps if situated near the orifice.
his fail, the urethra may be incised and the body extracted;
ısome urinary fistula is apt to follow this proceeding, even
) wound in the urethra has been carefully sutured.

is sometimes introduced voluntarily into the urethra, and is
r removed, since it has usually been pushed in head-foremost.
owing manœuvre is necessary in order to remove it: The
made to penetrate the floor of the urethra and skin by a
ısh on the head from behind. The body is pulled out until
catches against the mucous membrane, and then the direction
in can be changed, so that the head presents at or towards
ıus.

ted Calculus is a not unfrequent cause of retention in children.
ıually be felt through the walls of the canal. The symptoms
tment are much the same as for foreign bodies. When near
of the bladder, it should be pushed back into that viscus, if
and treated by lithotrity.

) **Urethritis** may arise from a variety of causes apart from
ea, *e.g.*, the presence in the female of an irritating vaginal
e, such as leucorrhœa, and possibly due to the *B. coli*. It
ırs after the passage of an instrument or of a calculus, and

of the mucous membrane. Full-sized soft instruments
t be used, and will usually succeed; if not, a silver instru-
t be substituted.

Stricture is the term applied to an undilatable condition of
a, resulting from the development of cicatricial tissue within

ses of organic stricture are: (*a*) The long continuance of a
ischarge, following gonorrhœa, or the frequent recurrence
ection. Chronic inflammations are always characterized
ncy to sclerosis of the tissues involved, and the urethra is
ion to this rule, its walls under these circumstances be-
ickened, indurated, and contracted. (*b*) The cicatrization
ral chancre, or of an ulcer caused by the impaction of a
the contraction produced by the healing of a urethral
ay also lead to stenosis. (*c*) The most intractable forms
e are those due to cicatrization after rupture or laceration
hral wall.

ual **Situation** is within the bulb, *i.e.*, just in front of the
ligament; but the orifice and body are not unfrequently
It occurs in the membranous portion only as a result of
n, and never in the prostatic. To find more than two
in any particular case is unusual, although three or four
met with.

terms are applied to a stricture according to the physical
present; thus, it is termed *annular*, if it involves the whole
the urethra; *bridled*, if it affects only a portion of the cir-
e of the tube. A *ribbon shaped* stricture is one in which a
ble extent of the wall is contracted (*i.e.*, as if a ribbon had
around the urethra). It is termed *tortuous*, if the resulting
not straight; *indurated*, if the walls are very hard and
; and *resilient*, when the stricture, though readily dilated,
contracts. The terms *impassable* and *impermeable* are applied
es through which, on the one hand, a surgeon is unable to
strument, or along which, on the other hand, urine cannot
ay; it is doubtful whether the latter condition ever occurs,
number of impassable strictures met with by the surgeon
s with his experience and ability in passing instruments.

mptoms of urethral stricture vary according to the case.
nt generally complains of difficulty in the act of micturition,
a becoming small, and perhaps forked or twisted. It takes
time than usual to empty the bladder, and even when
successful a few drops of urine may trickle away, wetting
it's clothes. Irritability of the viscus follows, leading to
ttempts to pass water at short intervals during the day
. The urine under these circumstances often becomes
nd loaded with muco-pus and phosphates. As the obstruc-
ases, more and more residual urine is left in the bladder,
y in time form a tense, rounded, dull swelling in the hypo-
The quantity of urine trickling away also increases, so

that the patient's garments are always wet, giving him an unpleasant urinous odour. A certain amount of gleety discharge is present, whilst if the individual takes an excess of alcohol, or is exposed to wet and cold, complete retention may ensue. Sometimes the onset of symptoms is so insidious that such an attack of retention is the first marked feature in the case.

The **Pathological Conditions** arising from a stricture are best considered under the following five headings: (1) The *urethra anterior* to the stricture is usually in a perfectly normal state, although possibly the orifices of false passages may be seen. A few granulations are sometimes present, projecting at the commencement of the stricture. (2) The *stricture itself* is characterized by the development of fibro-cicatricial tissue immediately under the mucous membrane, and intimately adherent to it. It extends for a variable distance, and is often associated with a good deal of peri-urethral infiltration. (3) The *urethra behind the stricture* is dilated, and the mucous membrane velvety and friable; the orifices of the lacunæ and other glands are somewhat enlarged and more than usually evident, and perhaps ulceration may be present around them. In the later stages the inflammation may extend to the peri-urethral tissue owing to lymphatic absorption, or perhaps to the escape of a few drops of urine; a perineal abscess then results, leading subsequently to perineal fistulæ. When the obstruction becomes almost absolute, this portion of the urethra may give way, leading to extravasation of urine into the perineum and scrotum. (4) The *bladder* invariably manifests considerable changes in structure. At first the vesical wall undergoes a compensatory hypertrophy of its muscular elements and is thickened, in order to overcome the obstruction to the onward passage of urine (Fig. 451). The lattice-work arrangement of the muscular bands becomes coarse, thickened, and evident, causing the vesical wall to assume a fasciculated appearance. As the pressure increases, the mucous membrane protrudes between the muscular fasciculi, giving rise to sacculation; it is also thickened and congested as a result of chronic cystitis; the superficial veins become varicose, and hæmaturia may be caused by their rupture, whilst ulceration may also occur. The urine becomes alkaline and decomposes, containing muco-pus and phosphates. It is likely to stagnate in any sacculi which exist, and may then determine the formation of phosphatic concretions; or the walls of the sacculi ulcerate, and after a time perforation and extravasation of urine into the cellular tissue lead to a fatal issue. Occasionally the bladder, instead of being thickened, is dilated and atonic, with very thin walls. (5) Consequent on the changes in the bladder, the conditions already described as hydronephrosis, pyonephrosis, or pyelonephritis may develop, partly as the result of the backward pressure, and partly from the extension of septic matter along the ureter to the pelvis of the kidney and calyces.

Physical Examination.—The actual diagnosis of a stricture can only be confirmed by a careful physical examination of the urethra, which is usually made by the introduction of a full-sized catheter or a

e.g., No. 9 or 10 (English), so as to ascertain where the is situated. If this cannot be passed, smaller instru- even filiform bougies, are inserted until one is found nter the bladder.

ariety of *catheters* is in use; in old days only metal instru- e obtain- ven now atheter is rite with ns of emi- selecting strument, be taken suitably that the sufficiently bevelled in- that no pro- im lacerates ral mucous . The great ges of the trument are easily kept nd that the be located guided more along the Of late years erent forms e catheters introduced, now exten- loyed, inas- hey give rise itation than le of metal. ions to them he materials they consist ly attacked ed by anti- ilst they are

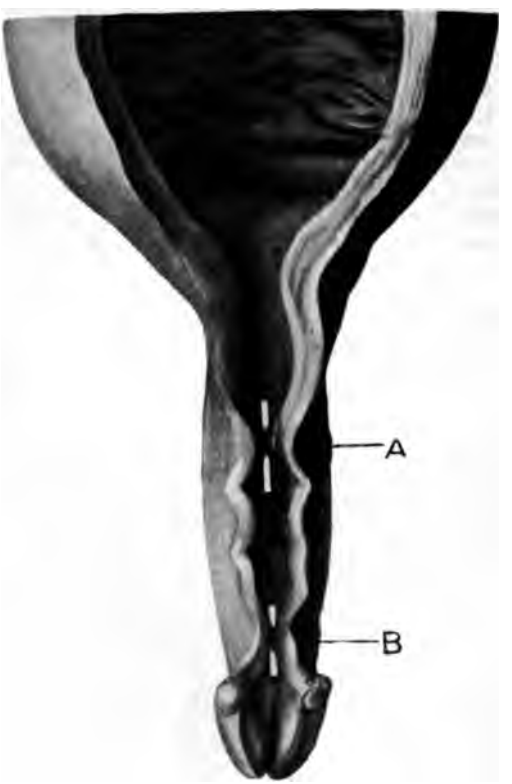


FIG. 451.—STRICTURE OF THE URETHRA. (COLLEGE OF SURGEONS' MUSEUM.)

At A and B strictures are seen, under which glass rods have been passed. The bladder is somewhat dilated, and its walls are thick and hypertrophic, and with commencing sacculation.

directed through a stricture on account of their flexibility, npossible to know with certainty the situation of the point. he best means of sterilizing a soft instrument is to expose action of steam, which should be made to act not only on ior, but also inside the tube; many appliances to obtain t have been devised. Amongst the best flexible instru-

is sometimes experienced, especially in sensitive in-
if an instrument has not been passed before. It may
a large extent by first introducing about ½ drachm of
solution of cocaine into the urethra.

ge may be induced by laceration or abrasion of the
brane, even though no false passage has been made;
ded by gentleness and the use of well-finished instru-
pite of these precautions, when the mucous membrane
gested, and in many cases of stricture, some bleeding
ded. It is rarely sufficient to call for special treatment,
undant may be arrested by the pressure of an instru-
r by injections of hazeline.

ages are frequently produced in the treatment of stric-
oint of the instrument is most likely to leave the canal
in the floor, travelling for a variable distance, according
employed, under the mucous membrane, occasionally
e dilated urethra behind the stricture, which it avoids
perforating the posterior wall of the bladder by tun-
the prostate, an accident which can only occur in
ds. The occurrence of a false passage is indicated by
ward movement of the instrument, combined with
orrhage; the point is usually deflected from the middle
inly seen by the obliquity of the rings at the end of the
e comes unless the urinary passages are opened behind
On rectal examination, the instrument can be felt out
line, and nearer the rectum than is normal, and in
nal cases has even been found in it. False passages
arily matters of great importance, but when extensive
peri-urethral suppuration and extravasation of urine,
ed by fatal results.

atory phenomena may be lighted up in the prostate,
didymitis induced by extension along the vas deferens;
ost always due to sepsis.

Fever, or, as it is sometimes termed, urethral or catheter
ys liable to develop as a result of the introduction of
It may occur as a solitary rigor even in individuals
urinary organs, but is much more frequently observed
damaged kidneys. As to its causation, there has been
ion, but there can now be little doubt that it is essen-
n origin. Possibly the instrument employed may be
urethra itself contains septic material, especially in its
It is quite sufficient for a slight abrasion to occur
of the bladder, to allow of the absorption either of
acteria, and then general phenomena show themselves
nerely toxic products are absorbed, probably a passing
ion, such as one or more rigors, will develop, with no
phenomena; but if bacteria find their way into the
ssues, they are likely to develop rapidly in the lym-
ding to the bladder and thence up the ureters owing

nt by **Dilatation** is effected in various ways, according ure of the stricture and the urgency of the symptoms. obstruction is not serious, and an instrument can be easily *dual dilatation* should always be employed; this consists of instruments once or twice a week, steadily increasing il a No. 12 is reached. If the intervals are too short, the y become irritated, spasm be induced, and the lumen of temporarily diminished in size; by keeping the patient a few days on a bland diet, and the bowels well open, the ppears. In cases where time is an object, *rapid dilatation* dertaken by the passage of several sizes of bougie at one r this purpose, Lister's instruments are particularly useful. ly a very small catheter can be introduced, and that with *continuous dilatation* may be adopted by keeping the patient l tying in the small instrument for forty-eight hours or more, iration of which period a catheter several sizes larger can ated. This in turn may be tied in if the patient can bear e presence of a catheter within the urethra for any length not always tolerated, and may give rise at the end of two ays to considerable constitutional disturbance and fever. *ilatation* is a plan which has now but few advocates. It the passage of an instrument, the shaft of which is made rtions, which can be separated from one another in such a destroy the stricture either by distension or rupture of its . It is but little used, on account of the great tendency, trization is complete, to the formation of an even more e stricture than before.

chever of these methods dilatation is accomplished, it is hat either the surgeon or the patient should subsequently strument through the stricture at first every week or two, at longer intervals, to overcome the tendency to re-contrac- is ever present.

atment of Passable Stricture by a **Cutting Operation** is con- her by excision or by internal or external urethrotomy.

is certainly the ideal treatment, the urethra being thereby o a normal condition. It has now been frequently under- l with great success in strictures of the deeper perineal f the urethra; it is not so satisfactory when the penile involved. Fully an inch of the tube may be excised, and utured together over a catheter. The corpus spongiosum etached from its surroundings to permit of this. Sutures uced in the upper wall first; then the catheter is placed in nd the remainder of the stitches inserted.

l **Urethrotomy** is a valuable means of treatment when nployed, but in careless or inexperienced hands may be with considerable danger. It has been performed either g an instrument through the stricture, and dividing it from rwards, or by passing an instrument down to the stricture, ing it from before backwards. The latter plan of treat-

of the groove, and inasmuch as it extends on to the shaft trument, the stricture is completely divided. Any fistulæ st are laid open into the median wound, and thoroughly id purified. A full-sized soft catheter is ed into the bladder, through either the he perineum, according to circumstances, ed in position for some days, the urine honed off in the usual way, whilst the vound, after all hæmorrhage has been packed with strips of antiseptic gauze, ed to heal by granulation The catheter d early or late according to the amount disturbance caused thereby, and subse- full-sized instrument can be passed into ler daily. Some surgeons have recom- he use of the so-called self-retaining in the hope of preventing urine from way through the external wound; several ave been suggested, but they are of little alue, since the escape of urine along the ie instrument can never be totally pre-

FIG. 453.—SYME'S HOULDERED STAFF FOR EXTERNAL URETHROTOMY. (DOWN BROTHERS.)

eatment of Impassable Stricture varies to whether or not the condition is com- ith retention of urine.

tention is present, it is possible that the to pass an instrument is due to some spasm or congestion induced by errors drink, or perhaps by exposure to cold. patient should rest in bed for a few days, s be well opened, the diet regulated, and containing some alkaline purgative and f henbane administered. Further attempts ientation should then be made, if neces- r an anæsthetic, and if the stricture still mpassable, *Wheelhouse's operation* (Fig. 454) d. This consists in incising the urethra in he constriction, tracing the passage back- d dividing it. A Wheelhouse's straight a median groove and a blunt hook at the serted down to the stricture, and the pened just in front of it by cutting down roove. The staff is then twisted round, end of the incision drawn up by the pro- the hook, and the sides of the urethra held apart with ceps. The orifice of the stricture is thus exposed, and ns may often be seen projecting from it. A fine probe- director can generally be insinuated along the urethra he stricture, which is then divided. A full-sized instru-

ment is passed into the bladder and retained for a few days, whilst the wound is allowed to heal by granulation.

If *retention of urine is present* in a case of impassable stricture, no time must be lost. If seen at an early stage, and the symptoms are not urgent, the patient is given a hot bath, and the bowels are opened by a warm enema, whilst a moderate dose of opium or preferably a morphia suppository is administered. If the urine is not passed naturally in the bath, and the bladder is becoming distended, being felt in the lower part of the abdomen, suprapubic aspiration, or puncture with a trocar and cannula, should be undertaken, and temporary relief thus obtained. Probably, when tension has been removed from the posterior part of the urethra, a catheter will be introduced without much difficulty. Failing this, aspiration may be several times resorted to, but it is generally wiser to open the urethra in front of or behind the stricture, and drain the bladder, since the risks of septic troubles, extravasation of urine, dangerous pressure upon the kidneys, and urinary infiltration along the lines of puncture, are thereby lessened.

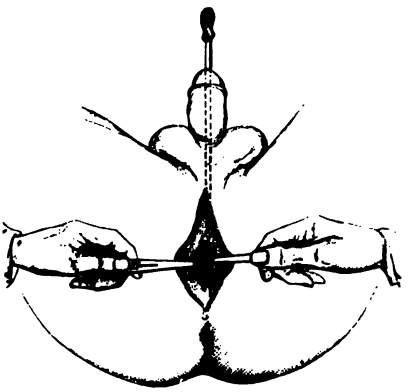


FIG. 454. — WHEELHOUSE'S OPERATION FOR IMPASSABLE STRICTURE. (BRYANT'S 'SURGERY.')

Cock's Operation, or **Perineal Section,** is sometimes adopted when no guide can be passed into the bladder (Fig. 455). The patient is placed in the lithotomy position, and the situation of the membranous urethra ascertained by inserting the index finger into the rectum. A median perineal incision is then made, and after dividing the cutaneous structures, the surgeon plunges the scalpel boldly in towards the apex of the prostate, guided by his finger in the rectum. He must keep strictly in the middle line, so as to avoid the impor-

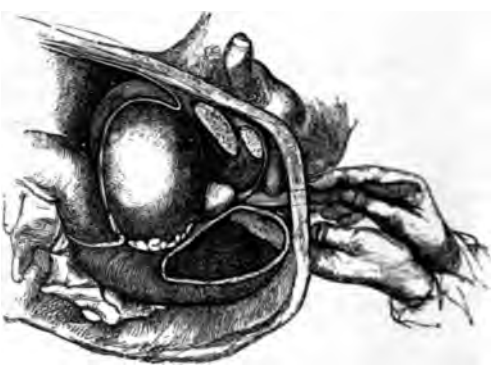


FIG. 455.—COCK'S OPERATION OF PERINEAL SECTION. (BRYANT'S 'SURGERY.')

ular and other structures which are so abundantly present rineum. As soon as the urethra is opened, a gush of urine apes; the upper urethral wall should not be damaged with , for fear of opening up the deep pelvic cellular tissue. peration may be tolerably simple if the urethra behind the is dilated, as is not uncommonly the case; but sometimes remely difficult, especially if the urethra has been displaced If the stricture is not situated too far from the incision, ays wise to complete the operation by dividing it, and a catheter can then be passed into the bladder, and the wound allowed to granulate. If the stricture cannot be th during the operation, and is of a dense cartilaginous tube is inserted into the bladder through the perineum; at the end of a few days the tissues will yield sufficiently

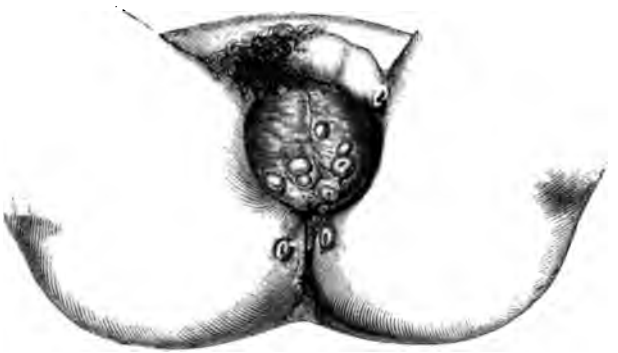


FIG. 456.—PERINEAL FISTULÆ. (BRYANT'S 'SURGERY.')

w of the passage of a catheter, or Wheelhouse's operation subsequently adopted.

chief **complications** of stricture other than those already ned are peri-urethral abscess, perineal fistula, and extravasa- f urine.

eri-urethral Abscess is due either to a limited extravasation e, or to the absorption of septic material through an ulcerated e. It is indicated by the formation of a hard, brawny swelling perineum or above the scrotum, which is tender to the touch. approaches the surface, fluctuation can be detected, and the over it becomes congested and œdematous. Constitutional bance and fever of an asthenic type are also present. Left to it bursts and usually gives rise to a perineal sinus or fistula, rging either pus or urine mixed with pus. One or many of fistulæ may occur (Fig. 456), and the openings are not limited perineum, but may also be found in the thighs, buttocks, or the groins. In chronic cases, the scrotal or perineal tissues ae infiltrated and of an almost cartilaginous consistency.

gnosis.—Every abscess in the scrotum or perineum is not neces-

arily associated with stricture, for simple irritation of the skin may ead to a superficial abscess; suppuration in the lacunæ, or Cowper's lands, may follow gonorrhœa; a prostatic or ischio-rectal abscess ıay point in the perineum; whilst the injury inflicted by the passage f instruments, or the existence of false passages, may lead to a milar result.

The **Treatment of a Perineal Abscess** consists in the application of mentations during the early stages; as soon as pus is present, it ıould be let out through a free incision, and it is often advisable) take the opportunity of dealing radically with the stricture by ection at the same time. Perineal fistulæ can rarely be cured with-ut operation, since, although the stricture may be completely dilated, ıe discharge of urine and pus continues. Under these circumstances yme's or Wheelhouse's operation is the proper treatment.

Extravasation of Urine is a condition due to a solution of con-nuity of the urethral walls, allowing the urine to find its way into ıe perineal and scrotal tissues. It usually results from over-disten-on of the urethra behind a neglected stricture; during some violent fort at micturition, the patient experiences severe pain and a sensa-on as if something had given way in the perineum, followed by a eling of relief. This, however, is of short duration, as it is soon ıcceeded by the local and constitutional effects of extravasation. ccasionally the onset of symptoms is more gradual, being preceded y a peri-urethral abscess, which bursts into the urethra; at each t of micturition the cavity becomes more and more distended with rine; finally the wall yields, resulting in diffuse extravasation. The ıme phenomena are produced in cases of traumatic laceration of ıe urethra if the patient attempts to empty his bladder.

The membranous urethra is almost always the site of the rupture, ıe urine finding its way subsequently through the anterior layer the triangular ligament, and being guided towards the anterior dominal wall by the arrangement of the fasciæ. The root of the enis, covered by its appropriate muscles, lies in an interfascial cul-e-sac, formed by the anterior layer of the triangular ligament above, ıd the deep layer of the perineal fascia (or fascia of Colles) below; ıese two layers are continuous, passing round the transversus erinei muscles, and are both attached laterally to the ischio-pubic ımi. Into this space the urine finds its way, after the anterior yer of the triangular ligament has yielded, and owing to the fact ıat its passage backwards and laterally is checked by the attach-ent of the fasciæ, it is necessarily forced forwards, infiltrating in der the perineum, scrotum, and body of the penis. If more ex-nsive, it travels along the spermatic cords to the anterior abdominal ırietes, its passage downwards into the thighs being prevented by the tachment of the deep layer of the superficial fascia of the abdomen the fascia lata just below Poupart's ligament. In the most severe ıses the urine may even find its way as far as the axillæ.

The **Effects** of extravasation of urine are always serious. Possibly, the urine were pure and aseptic, part of it might be absorbed; but

en prolonged infiltration of the tissues is likely to result in
ttion and sloughing. In cases of stricture, however, the urine
ost certain to be foul and alkaline, and hence wherever it
it gives rise to a gangrenous cellulitis. The parts at first
infiltrated and brawny, but soon emphysematous crackling
refaction are observed, owing to necrosis of the cellular tissue.
ngested and œdematous skin turns to a dusky purple or black
and finally gives way or separates, allowing exit to a mixture
urine, and decomposing slough of a most offensive and pene-
odour. The superficial loss of substance may be so extensive
ay bare both testicles, and even the body of the penis, or
the anterior abdominal wall. The inflammatory process is
rily associated with severe constitutional disturbance, at first
erized by high fever and a quick, bounding pulse; but later on
perature may become subnormal, and the patient profoundly
d from toxæmia.

Treatment consists in early and free incisions, so as to give
the urine and pus, and to prevent, if possible, the sloughing
kin and subcutaneous tissues. Every part that the urine has
ed must be dealt with in this way; thus the perineum should
ed in the middle line; the scrotum is similarly divided, if
, down to the urethra, the testicles being laid on either side,
ossible, this should be avoided. The penis should be incised,
sary, on either side of the urethra, and along the dorsal
. It is often possible to expel a large portion of the urine,
ly in the scrotum, by firmly squeezing the infiltrated tissues.
ized catheter must be passed into the bladder, and to effect
urethra has often to be laid open and the stricture divided;
l drainage is always preferable for these cases. The parts
be subsequently dusted over with iodoform, and dressed with
ntiseptic applications, *e.g.*, a charcoal or carbolic linseed
, or boracic fomentations. Frequent hip-baths should be
d, and, if practicable, a continuous sitz-bath would be the
st means of treating the case. As soon as the wounds
clean, they should be dressed in the ordinary way to allow
granulate. The general health of the patient must of course
ded to, plenty of easily assimilated nourishment, stimulants,
nine being administered.

ry Fistulæ are most commonly found in the perineum,
, or body of the penis. They usually result from peri-
l suppuration in connection with a stricture, but are occa-
due to other causes, *e.g.*, a lacunar abscess after gonorrhœa,
static abscess. They vary much in size and number; when
lt of a stricture, many may be present (Fig. 456), and great
ion of the surrounding tissues is usually produced. The
nt of perineal fistulæ has been already in measure described,
l urethrotomy being necessary if a stricture exists. Occa-
the perineal wound does not close after such an operation,
en the stricture has been divided; the edges of the fistula

removal of sufficient tissue on the under side to prevent the ly projection so frequently seen just below the frænum. In several vessels will bleed and require to be ligatured, especially the frænum, but in a child the hæmorrhage is trifling. carefully trimmed up the edges, and snipped off all ragged so as to render the margins of the wound regular, catgut are inserted to prevent any raw surface being left exposed; dren only a few are required, but possibly a considerable r in adults; a continuous suture should never be employed. ound is dressed with strips of gauze or lint dipped in carbolic l around this, again, a wisp of antiseptic wool; no bandage is required. In adults con-

FIG. 457.—REDUCTION OF PARAPHIMOSIS.

le after-trouble may be experi- from nocturnal erections, which so marked and prolonged as to rough the stitches; to control patient's bowels should be freely , and he should be kept on a low stimulating diet, and bromide of um or other sedatives adminis-

The stitches are usually re- at the end of five days, and the are then dusted over with a e of powdered boric acid, zinc and starch, so as to reduce their veness.

n a phimosed prepuce is com- retracted, the patient often finds ossible to replace it, thus giving rise to a condition known as **imosis.** It is due to the narrow orifice of the prepuce getting the corona, and is characterized by great œdema and con-, not only of the exposed mucous membrane, but also of the tself. If left untreated, ulceration takes place along the line istriction, and the parts become fixed in their deformed n, the vessels sooner or later accommodating themselves to w conditions, and the œdema slowly disappearing. In some loughing of the glans may occur.

tment consists in forcible replacement of the prepuce. This mplished by grasping the penis between the first and second of each hand, and compressing the glans penis with the thumbs empty the vessels and diminish the amount of œdema present, us reduce its size (Fig. 457). At the same time the fingers he prepuce forwards, and thus finally reposition is effected. the œdema of the prepuce is very marked, it should be punc- n several places to permit the escape of serum and diminish sion, previous to reduction as just described. In more advanced eposition becomes impossible, and then the narrow constricting aused by the orifice of the prepuce must be divided on the aspect. This will free the parts, which can be subsequently

papillated, wart-like outgrowth, or as a diffuse infiltra-
ng early, and leading to n siderable destruction of
8). At first the tumour is mainly beneath the prepuce,
es distended, producing a sanious discharge, which
elial cells as well as pus corpuscles; but as the case
ie prepuce itself is attacked, and even perforated.
body of the penis is invaded, and owing to its great
ie disease makes
s. The inguinal
irly affected, but
y of the penis is
lumbar glands
cated.
sis of epithelioma
easily made by
ie infiltration of
iced by the former
and normal con-
glans in the latter

ment of epithe-
s in amputation
s whenever the
ciently limited to
ope that it can be
When confined to
of the organ, the
possibly be per-
gh the body; but

FIG. 458.—EPITHELIOMA OF PENIS. (KING'S COLLEGE HOSPITAL MUSEUM.)

re logical and more in accord with modern scientific
ve the whole organ

through the body of the penis is an operation of but little
short flap is reflected from the dorsum, and the
nosa cut through, the urethra and remaining portions
being removed at a lower level. Bleeding is then
ecuring the divided vessels; five ligatures are usually
one for the artery to the corpus cavernosum on either
ach dorsal artery, and one for the artery to the septum.
s then isolated, and passed through an opening made
ntegumental flap. It is split along its upper wall, and
itures to the margins of the opening, so as to prevent
traction; the flaps are then united by stitches.

of the whole penis is a more serious, but very successful,
he patient is placed in the lithotomy position, and the
er being shaved and purified, incised freely in the
The corpus spongiosum is traced backwards, and
h a level as to allow the mucous membrane lining the
ion of the urethra to be stitched to the skin at the
le of the incision. The corpora cavernosa are freed

CHAPTER XLI.

ECTIONS OF THE TESTIS, CORD, SCROTUM, AND SEMINAL VESICLES.

Affections of the Testis.—It is scarcely necessary to state that the
e not developed in the scrotum, but from the posterior wall of the
cavity, so that they lie at first behind the peritoneum close to the
The body of the gland arises from the so-called genital ridge, which is
columnar epithelial cells, and lies to the mesial side of the Wolffian
vasa efferentia are developed from the tubules of the latter structure,
to relation at a later date with the seminal tubules; the vas deferens
by the Wolffian duct.

ually the body of the testis is entirely absent, whilst a few cases are
of absence or deficiency of the vas. Very rarely two testicles have
oped on one side, and have both found their way into the scrotum
n).

age of the testis from the abdominal cavity to the scrotum takes place
e end of the eighth month of intra-uterine life. 'The gubernaculum
ne active agent in bringing about the descent of the testis. This is
of involuntary muscular fibres which traverses the inguinal canal, and
es important connections both within and without the abdominal cavity.
hree main attachments of the gubernaculum may be recognised, viz.:
e abdominal wall; (*b*) to the pubis; (*c*) to the bottom of the scrotum.
the gubernacular fibres are chiefly connected with the testicle; but
them are also attached to the peritoneum on the posterior wall of the
n. By the traction which the gubernaculum exerts on the testicle, the
of that organ is brought about. By the portion attached to the abdominal
testicle is pulled down to the internal abdominal ring, the pubic portion
through the inguinal canal, whilst the scrotal part finally leads it into
tum.

formation of the processus vaginalis is accounted for in the same way.
those gubernacular fibres which are inserted into the peritoneum drag
ie peritoneal diverticulum which lines the inguinal canal and scrotum,
pares the way for the testicle.' (Cunningham's 'Manual of Anatomy,'
p. 426, 427.)

hief forms of malposition of the testis are described, arising either from
nplete or abnormal descent.

mplete Descent or Retention of the Testis.—The testis may remain in
minal cavity attached to the abdominal wall by a mesorchium (*retentio
alis*); more frequently, it is found just within the internal abdominal
entio iliaca); but most commonly it occupies the inguinal canal, or lies
side of it (*retentio inguinalis*). The organ in the latter position is freely
being readily pressed up towards the abdominal cavity. The **Causes** of
dition must be looked for mainly in some abnormal attachment of the
culum, or possibly in the existence of intra-uterine peritonitis. Less

commonly a contracted condition of the external abdominal ring, or an unduly large epididymis, may determine its occurrence.

The condition is easily recognised by the absence of the testicle in the scrotum, and in the inguinal variety the organ can usually be detected as a small moveable swelling about the size of a horse-bean, giving the characteristic testicular sensation on pressure. The scrotum on the affected side is imperfectly developed.

In any of these varieties a late descent of the testis may occur, usually accompanied by a congenital hernia, possibly of an interstitial type.

2. **Malposition of the Testis.**—Two distinct forms are described: (*a*) *Ectopia Perinealis.*—In this variety the testis finds its way into the perineum, slipping along the groove between the thigh and the scrotum. It may exist as a congenital condition, being then due to the contraction of an accessory band of gubernacular fibres; or it may happen in consequence of a late descent of the testicle, owing to atrophy of the scrotum. It always causes considerable inconvenience to the patient, especially on sitting or riding. (*b*) *Ectopia Cruralis.*—The testicle here lies on the inner side of Scarpa's triangle, in the region of the saphenous opening. It is said to escape along the crural canal, but more probably it passes down the inguinal canal as usual, and then finds its way over Poupart's ligament to this situation, guided by a second accessory band of gubernacular tissue. When, as not uncommonly happens, a congenital hernia also exists, it may travel outwards to the anterior superior spine, being directed there by the arrangement of the fasciæ, as in a femoral hernia (extra-parietal interstitial hernia, p. 1071)

In cases of retained or misplaced testis the spermatogenic function of the organ is rarely developed, or at most merely for a year or two about the age of twenty. Pain is not unfrequently complained of, coming on in bouts which last for a short time and then disappear, probably due to slight injuries or torsion. Fibrosis of the testis follows in time, and total degeneration is the ultimate outcome. If only one organ is affected, but little harm follows; but if both are involved, the individual is probably sterile.

Complications of a Retained or Misplaced Testicle.—Any of the conditions to be described hereafter in this chapter may involve a retained or misplaced testicle, just as if it were in the scrotum, and give rise to considerable trouble, especially when the organ is lying in close proximity to the peritoneum. A testis misplaced or retained in the inguinal canal is much exposed to injury, and a subacute traumatic orchitis often occurs. It is stated that such organs are very prone to become the seat of malignant disease at a later period of life, but the accuracy of this statement is a little doubtful.

Treatment.—Taking into consideration the discomfort occasioned by this condition, as well as the risk arising from the tendency to malignant disease, there can be little doubt that the best method of treatment is the removal of the testicle. Many operations have been devised with the idea of placing the organ in its normal position in the scrotum, but the majority of such methods have proved useless, owing to the defective length of the spermatic vessels and cord; moreover, the traction and handling required to draw the organ down into the scrotum may determine the occurrence of fibrotic changes, even if they are not already present. Some authors advise the replacement of the organs in the abdominal cavity in patients before the age of twenty-three, but it is doubtful whether much value is to be attached to such a suggestion.

Another condition met with congenitally is **Inversion** of the testis, the epididymis lying in front, and the body of the organ behind. It is of no clinical significance, except that in careless hands it may be injured whilst tapping a hydrocele.

Torsion of the Spermatic Cord results in acute strangulation of the testis. The cause still remains unknown, but several of the cases recorded have been associated with late descent of the testicle, and others have been attributed to twists and strains. The symptoms are tolerably characteristic: the patient complains of an acute sickening pain in the testis which persists until gangrene has supervened, and may then disappear; it is accompanied by a certain amount of pyrexia, and the appearance of a tumour, either in the inguinal region or in

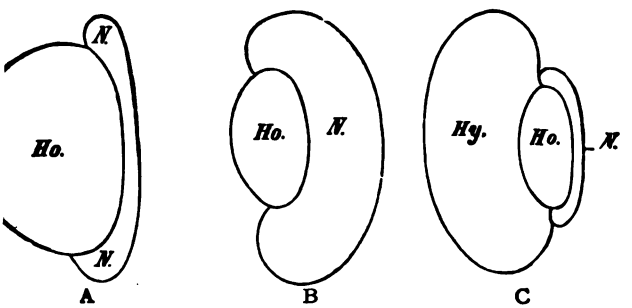
. The testicle, slightly enlarged, is felt below, and above it a larger
ting of the twisted cord and the congested and swollen epididymis.
es the latter swelling has been crepitant, owing to the development
e to its putrefaction. The condition is very likely to be mistaken for
ed hernia, which it closely resembles; but the presence of fever, and
of abdominal distension and of fæcal vomiting, are important dis-
ns; moreover, constipation, though often present, is never absolute.
is situated in the scrotum, the cord and inguinal canal are found to be
t if in the canal, the affected side of the scrotum is empty. The only
possible is exploration and removal of the inflamed or gangrenous
ord, unless the case is seen very early, when it may be feasible to

of the Testis and Cord.— **Contusion** is a very common form
It arises from blows, kicks, squeezes, and the like, and is
sociated with immediate pain of a most sickening and in-
acter, which is not only experienced in the testicle, but also
long the cord towards the loins and back, and down the
ie thigh. Severe shock accompanies the pain, and may be
id as to lead to a fatal issue. A well-marked traumatic
ften follows, and this may in turn induce atrophy of the
hough the same condition sometimes occurs without much
f inflammation, as a result of thrombosis and occlusion of
atic vessels. A hæmatocele is also induced by a sub-
lesion of this nature. **Treatment** consists in keeping the
the recumbent posture with the scrotum well raised, and in
omentations or an icebag.
ting Wounds or **Punctures** are uncommon except as a result
l treatment (*e.g.*, tapping a hydrocele). A certain amount
rhage usually follows, whilst the immediate lesion is asso-
h severe testicular pain. If the wound becomes septic, the
e likely to protrude, and a hernia testis may result. All
linarily required is to purify the parts and allow them to
ures should not be inserted into the tunica albuginea, if
ny doubt as to the wound being sterile. If the gland is
organized, castration must be undertaken.
ocele, or a localized collection of blood in the tunica vaginalis
; a common result of injuries.
atocele of the Tunica Vaginalis arises from traumatism, such
n blow or severe strain, and occasionally follows the tap-
hydrocele if a superficial vessel has been ruptured or punc-
f the body of the testis has been wounded; it may, however,
general oozing from dilated capillaries in the serous mem-
ng to the sudden relief of tension. It also occurs more or
aneously in connection with malignant disease. The **History**
given is that the patient was seized with a sudden sicken-
a the testicle, which became quickly enlarged without any
f inflammation. If blood is extravasated at the same time
scrotum, the integument becomes discoloured in the course
ays owing to a diffusion of the blood pigment. At first the
smooth and fluctuating, exactly resembling a hydrocele,
the absence of translucency; but owing to a deposit of

er case the term **Orchitis** is applied to it, in the latter itis; as the case progresses both portions are involved in ss; either condition may be acute or chronic.

Orchitis most frequently results from injury, but it is also as a primary affection in gouty and rheumatic individuals, s arising spontaneously; or it may follow mumps, typhoid, eruptive fevers, as a result of metastasis, whilst it is always extent associated with epididymitis. In mumps it may pre- parotid lesion, or may even occur without it.

esticle becomes considerably enlarged, exceedingly painful, er to the touch. The shape of the organ is more or less (Fig. 459, A), whilst the pain is of a peculiarly sickening r, extending upwards along the course of the cord towards



59.—Diagrammatic Sections of (A) Orchitis, (B) Epididymitis, and (C) Hydrocele of Tunica Vaginalis. (Tillmanns.)

Ho., Testis; *N.*, epididymis; *Hy.*, hydrocele.

k and loins. The scrotal integuments become red and in- , and, owing to the acuteness of the process, more or less t to the coverings of the gland. A plastic or serous effusion tunica vaginalis is sometimes present, giving rise to what is as an 'acute hydrocele.' Some constitutional disturbance anies the process, the temperature being elevated two or three whilst vomiting and constipation are marked symptoms. It al for suppuration to ensue, but an abscess occasionally forms, , after the pus has been let out, a hernia testis may follow. ' is a more common sequela, especially in adults, being caused triction of the vessels and tubules, owing to organization of mmatory exudation.

Epididymitis is almost always due to the extension of an atory process from the urethra, the usual cause being gonor- it occasionally follows the passage of instruments or the it of a calculus; or it may be secondary to a suppurative is, unconnected with gonorrhœa. It is ushered in by pain nguinal region and perhaps in the hypogastrium along the of the vas deferens, which soon extends to the scrotum,

The testicle becomes enlarged, but its shape is that of an elongated oval, somewhat flattened laterally. The epididymis is readily felt as a crescentic swelling, partially overlapping the gland in all directions, and in its concavity the rounded outline of the anterior wall of the testis can usually be distinguished (Fig. 459, B), or the tunica vaginalis distended with fluid. The scrotum is red, œdematous, and adherent to the testis, whilst the cord is infiltrated, enlarged, and tender. The same constitutional symptoms are met with as in orchitis. Suppuration is perhaps more common than after the latter affection, since the condition is usually due to a suppurating inflammation of the deeper parts of the urethra; but it is a rare complication. Atrophy of the testis is a not unfrequent result in cases which are not efficiently treated, the plastic material exuded into the epididymis being organized into fibro-cicatricial tissue, and constricting the spermatic vessels; an acute attack of double epididymitis may in this way render the individual sterile.

The *Treatment* of both these conditions in the acute stage consists in keeping the patient in bed, with the scrotum supported on a small pillow. The part is assiduously fomented, except when the case is seen very early, an icebag or Leiter's coil being then employed. Leeching should not be utilized, as the triangular leech-bites are very liable to become irritated and septic, and never heal well in the scrotum; if local abstraction of blood appears desirable, one or more of the scrotal veins may be punctured; the hæmorrhage is easily arrested by elevating the part. Pain, if severe, may be mitigated by a hot sitz-bath, or by morphia suppositories. As regards general treatment, the patient, after a preliminary dose of calomel, is kept on a fluid, unstimulating diet, whilst alkaline purgatives are administered, with the addition of tincture of henbane or opium as a sedative; if the pulse is hard and the temperature high, vinum antimonialis in 10-minim doses is also beneficial. When the acute stage is passed, the organ usually remains enlarged, and for a time somewhat tender; it is then best treated by strapping with lead plaster, or with the emplastrum ammoniaci cum hydrargyro. This must be continued until all signs of thickening and induration have disappeared.

Subacute or **chronic** forms of inflammation are also met with affecting the testis or epididymis, either as a consequence of the above, or resulting primarily from blows or strains. The characteristic enlargement is readily detected, associated with a certain amount of tenderness. A useful diagnostic point between the chronic epididymitis following gonorrhœa and that due to syphilis is that the former usually involves the globus minor, and the latter is almost limited to the globus major. The condition is best treated by strapping, and perhaps the administration of small doses of mercury and iodide of potassium may assist in the absorption of the inflammatory products. Chronic orchitis is very similar to the enlargement produced by syphilis, from which, indeed, it can only be distinguished by the absence of a syphilitic history.

rculous Disease of the Testis (*Syn.:* **Tuberculous Sarcocele, Tuberculous Orchitis**).—This affection is most commonly seen g adults with a distinct tuberculous history, but it also occurs rwise healthy individuals. It may commence as a primary n of the epididymis, or may be secondary to tuberculous elsewhere.

logical Anatomy.—The process originates in the connective f the epididymis, and runs its usual course, at first consisting of miliary elements deposited around the vessels, which by alescence and n lead to the on of cheesy and these at r stage may and give rise sses. It may ed to any one he epididymis often the globus , or may widely te its substance, a general en- ent (Fig. 460). latter case it ends to spread, into the body testis or along deferens. The s Highmori- becomes first d by a similar ; and finally the bular connec-

FIG. 460.—TUBERCULOUS DISEASE OF TESTIS, MAINLY INVOLVING THE EPIDERMIS AND CORD. (KING'S COLLEGE HOSPITAL MUSEUM.)

sue of the gland; this is always associated with overgrowth epithelium in the tubuli seminiferi, the cells after a time oing fatty degeneration, and perhaps to such an extent that, roscopic section, the normal appearance of the organ has disappeared. An abscess may form within it, and find its the surface by burrowing through the tunica albuginea, the l and parietal layers of the tunica vaginalis having previously adherent. After the pus has escaped, a hernia testis is o develop. If the process extends upwards along the cord, is mainly implicated, becoming perceptibly thickened, the tructures of the cord being but little affected. The disease along the vas on the outside of the bladder to the vesiculæ les and prostate, and may even involve the base of the bladder, ters, and kidneys. Lastly, general dissemination of tuber- disease may occur, and it is a curious fact that meningeal f is frequently associated with genital tuberculosis.

—a retention the more important owing to the likelihood of the ar testis being subsequently invaded. If the vas is thickened at external abdominal ring, it need not deter the surgeon from rating, even if the vesiculæ are enlarged, since tuberculous disease ot like cancer; if the great bulk of the mischief is removed, ture can frequently eliminate any small portion that remains. In h cases the inguinal canal should be freely opened, and the vas ed backwards and divided. In one case thus dealt with the lder was distended with boracic lotion, the patient placed in the ndelenburg position, and the vas fol- ed back along the side of the bladder rly as far as the seminal vesicles. tuberculous disease of the seminal cles, see p. 1264.

astration (p. 1263) is reserved for s where the testis is disorganized, its value as a secreting gland totally royed. Of course the cord is then oved also after its division as high up ossible.

rphilitic Disease of the Testicle.—The cle may become affected by syphilis, er in the late secondary or in the ary stage; most commonly it results the acquired variety, but occasionally et with in the inherited.

FIG. 461. TERTIARY SYPHILITIC DISEASE OF TESTIS WITH GUMMA OF THE BODY. (TREVES' 'SURGERY.')

condary Syphilitic Epididymitis is very frequently seen. It occurs in form of a chronic enlargement of epididymis, associated perhaps with a hydrocele, about six to ve months after infection. The case is very similar to a simple nic epididymitis, but the nodular thickening mainly involves the ous major, and is usually symmetrical. It readily disappears on administration of mercury.

Tertiary Syphilitic Orchitis is observed at a much later period of disease, even twenty or thirty years after infection. It is not unquently bilateral. **Pathologically**, it resembles the majority of tiary manifestations in consisting of a diffuse infiltration accomied by overgrowth of the connective tissue. If the process affects ually the whole organ, the ordinary syphilitic sarcocele or sclerosis the testis results; if it is more localized in its distribution, the mmatous variety is said to be present (Fig. 461). The former ection is much more common than the latter.

In the tertiary syphilitic sarcocele, the body of the testis is marily involved, and becomes evenly enlarged and stony hard. is globular in outline, frequently accompanied by a hydrocele, l the normal testicular sensation early disappears. The same cess occasionally extends to the epididymis and cord. Suppura- n is exceedingly rare. On section the characteristic appearance

st be distinguished from the fungating growth which occasionally ılts from malignant disease of the organ, when the protrusion sists of tumour substance, with no trace of testicular tissue.

'he **Treatment** of hernia testis usually consists in extirpation of organ, especially when it is affected by tuberculous disease. In ple cases it may be possible to obtain healing of the wound by ping the part aseptic, and applying pressure by means of a pad gauze. In other cases ıay be possible to sepa- the mass, and after ıng the edges of the ınd, to bring them to- ıer by sutures, and thus er in the gland sub- ıce, which, however, ains projecting from opening in the tunica ıginea. Such proceed- are seldom very satis- ɔry.

ımours of the Testis generally malignant in 'acter, only one non- gnant form being at common, viz., fibro- ic disease, or adenoma s.

ibro-Cystic Disease .: Adenoma Testis, ic Sarcocele). — This lition is characterized the formation of a nour of variable size, attered through the sub- ınce of which are numerous cystic cavities, lined with cuboidal or 'atified epithelium. These cysts are usually rounded, but occa- ınally tubular in shape, and may communicate with one another; ɔy contain serous fluid and sometimes intracystic growths. They ɔ surrounded by connective tissue, the amount and character of ıich vary greatly in different cases. It consists mainly of simple rous tissue, but it is very common to see cartilaginous nodules ig. 462, 2) and myxomatous foci scattered through its substance, d is very prone after a time to undergo a malignant transformation. cording to Bland Sutton and Eve, these tumours arise from the nains of the Wolffian body or mesonephros, which is almost ways normally represented in the neighbourhood of the globus jor of the epididymis by the structure known as the organ of ıaldés (paradidymis). The testicle can be found in most cases ead out in a thin layer over the tumour substance (Fig. 462, 1).

FIG. 462.—FIBRO-CYSTIC DISEASE OF THE TESTIS. (COLLEGE OF SURGEONS' MUSEUM.)

1, Body of testis spread out over the growth; 2, nodules of cartilage contained in the growth.

tinguish a carcinoma from a sarcoma of the testis by clinical signs, ce it usually occurs at the same period of adult life, and very rarely :hildren. Very rapid growth, and early enlargement of the cord l lymphatic glands, point, however, to cancer rather than sarcoma. e only treatment is castration.

Hydrocele.—Any collection of fluid, other than pus or blood, in neighbourhood of the testis or cord is termed a hydrocele. The d usually consists of serum, but in some forms spermatozoa are) present, and in rare cases it may consist of chyle or a similar ky fluid (chylous hydrocele). Two chief varieties are described, ording to whether the testis or the cord is involved.

. In **Hydrocele of the Testis** the fluid is contained in the tunica inalis (vaginal hydrocele) or exists as a circumscribed swelling in neighbourhood (encysted hydrocele).

. A **Vaginal Hydrocele** is one in which there is an accumulation fluid in the tunica vaginalis, and the following varieties may be erentiated :

a) *Acute Hydrocele* occurs in conjunction with acute inflammation :he testis or epididymis. The effusion of fluid is never abundant, . is often only made out on careful examination ; at first it consists plasma, as in all acute inflammations of a serous membrane, and herefore spontaneously coagulable. It may become chronic, or y disappear entirely, perhaps leaving a few adhesions.

b) A *Congenital Hydrocele* occurs in cases in which the funicular cess is still patent. The general signs of a vaginal hydrocele, as cribed below, are present, but the fluid can be returned by ssure into the abdominal cavity. It is rarely seen in others than nts, and may be treated by the application of evaporating lotion he scrotum, whilst a light truss or woollen support is placed over inguinal canal, as for congenital hernia. It is often associated a phimosis, which should, of course, be dealt with by circumcision. : persists, it may be treated by operation as for congenital hernia, which, indeed, it frequently leads.

(*c*) An *Infantile Hydrocele* is due to non-obliteration of the funicular ocess of peritoneum, except at its upper extremity. It presents e signs of an ordinary acquired hydrocele, the fluid, however, tending along the cord, even into the inguinal canal. Its treat- ent is the same as for an acquired hydrocele.

(*d*) A *Bilocular Hydrocele* is one in which there is an additional culus within the abdominal cavity, communicating by a neck of riable size with the distended tunica vaginalis. It is due to a rsistence of the intra-abdominal portion of the funicular process tween the peritoneum and internal abdominal ring ; this becomes stended with fluid, and the collection burrows downwards in front id by the side of the bladder towards the pelvis. We have operated a similar condition in a woman, originating in the upper portion the canal of Nuck.

(*e*) *Acquired Vaginal Hydrocele* is the most common variety.

where inflammation of the testis exists, to apply cooling lotions. chronic orchitis strapping of the testis may be required. In *to tap a hydrocele*, the tumour must be firmly grasped in the palm e left hand, and the skin over its anterior wall purified and made . A spot at the antero-inferior margin is then selected, as free vessels as possible, and a fine sterilized trocar and cannula in- l almost directly upwards, so as to pass in front of the body of stis. The site selected for tapping must, of course, vary with osition of the testicle, which should be previously demonstrated. fluid having been withdrawn, the cannula is removed, and the ture covered with wool and collodion. The condition usually rs after a longer or shorter period, and the operation may then be eated. If a dirty instrument is employed, inflammation, and even puration, may follow, whilst if a vessel or the body of the testis unctured, a hæmatocele may result.

lany different plans have been suggested for the **Radical** treatment ydrocele. It is unnecessary, however, to do more than describe two most frequently adopted. (i.) *Injection* of the cavity after ing has long been a favourite method. Many different reagents e been employed, such as port wine, tincture of iodine, solution orrosive sublimate (1 in 500), or glycerine of carbolic acid. Per- s the best is the tincture of iodine, but that contained in the ish Pharmacopœia is not strong enough, and the old Edinburgh ture, which is nearly the same strength as the lin. iodi, B.P., ld be employed. The amount used varies with the size of the rocele, but for one of moderate dimensions it will suffice to inject, tapping, 2 drachms of the tincture, and after manipulating it within the cavity, a part, say 1 drachm, is allowed to escape, rt inflammatory reaction follows, and a cure may result, probably obliteration of the vaginal space by the formation of adhesions. certain percentage of cases failure may be expected, and this ore likely to happen if too weak an irritant has been em- ed, or if the hydrocele is a chronic one with thick and indurated s, or has been tapped on several previous occasions. (ii.) The *method* of operation is now generally adopted, and is particularly mmended in large and chronic cases. The hydrocele is cut down rough an incision in the upper part of the scrotum, and the tunica alis isolated from the superjacent structures. The cavity is ed, and the parietal portion of the tunica snipped away with ors close to the testicle. A number of vessels will need to be ured; a drainage-tube is inserted, and the wound closed in the ary way. The results of this practice are most satisfactory.

hen the sac is not too large, and the tunica supple and uninfil- d, it often suffices to turn it inside out after opening it, and ing its edges to the back of the testis or epididymis. We have ated in this way on many cases and with excellent results.

a infants hydrocele is by no means uncommon, and may be, but ot always, of the congenital type. The communication is some- es very small, so that reduction is impracticable, although on

lying up the cavity slowly empties; it is desirable to make certain as to this point before undertaking treatment. If the sac communicates with the peritoneal cavity, it may be treated as a hernia by truss pressure, or more satisfactorily by operation. If no communication exists, many cases get well spontaneously, but as a useful *placebo* the scrotum may be painted over frequently with a lotion of chloride of ammonium (grs. x. ad ʒi mixed with rectified spirit and water); failing this, acupuncture may be tried, the fluid being allowed to trickle into the scrotal tissues: in the few cases in which this fails, an open operation (incision with drainage or partial removal of the sac) will be required.

FIG. 464.--ENCYSTED HYDROCELE OF EPIDIDYMIS. (COLLEGE OF SURGEONS' MUSEUM.)

2. **Encysted Hydrocele** of the testis occurs in two main forms, according to whether it arises in connection with the epididymis or the body of the testis.

(*a*) *Encysted Hydrocele of the Epididymis* exists usually as a rounded globular swelling, tense and elastic in consistency, and translucent. It is situated above the body of the testis, and close to the head of the epididymis (Fig. 464). As a rule, it does not attain a size greater than that of the body of the testis itself, so that it may appear as if a double testicle was present; the hydrocele is, of course, devoid of testicular sensation. Less frequently it may attain considerable dimensions, even projecting below and around the testicle, which, though enveloped by it, is quite distinct from it. The fluid contained within these cysts is usually milky and opalescent in appearance, owing to an admixture of semen; under the microscope spermatozoa, either living or dead, can be demonstrated; on account of this it is sometimes termed a *spermatocele*. The specific gravity is lower than that of ordinary hydrocele fluid, and there is but little albumen. The origin of these cysts has given rise to much discussion. They are of a very different nature to the ordinary vaginal hydrocele, or even to the encysted hydrocele of the cord, since the walls are not lined with endothelium, but with cuboidal or columnar epithelium. They are probably due either to a dilatation of one or more of the vasa efferentia testis, or more frequently to distension of some of the fœtal relics always found near the head of the epididymis, especially of those known as Kobelt's tubes; these, as also the vasa efferentia testis, are derived from the tubules of the Wolffian body, differing,

vever, from them in not becoming attached to the body of the tis (Fig. 58, p. 217). They are thus homologous with the parovarian ts found in the female. Smaller pedunculated cysts containing ar serum are sometimes met with in this region, arising from a tension of the hydatid of Morgagni, which is developed from the ıains of the Müllerian duct.

reatment is conducted along the same lines as for vaginal hydro-e, viz., by tapping as a palliative measure, and injection or ex-on, in order to establish a radical cure.

b) *Encysted Hydrocele of the Tunica Albuginea* is a condition rarely n, consisting of a small collection of serous fluid beneath the vis-al portion of the tunica vaginalis. It is probably due to dilatation ymphatic spaces, and has absolutely no clinical significance.

I. **Hydrocele of the Cord** occurs, as already described, in connec-ı with the congenital and infantile varieties of vaginal hydrocele. imited to the cord, it exists in one of two forms, the encysted or diffuse.

. **Encysted Hydrocele of the Cord** arises from imperfect obliteration :he funicular process of peritoneum, the patent portion becoming ended with fluid and giving rise to a cavity lined with endothe-n. It is usually detected as a rounded elastic swelling, occupying inguinal canal, moving freely up and down within it. The upper der is sharply limited, and in favourable cases translucency can lemonstrated. On fixing the testicle the cyst is no longer move-e. The fluid contained within it is identical in nature with that . vaginal hydrocele. In the female a similar condition arises from ıerfect obliteration of the canal of Nuck, giving rise to what is wn as a *hydrocele of the round ligament*. **Treatment** consists in oval of the fluid by tapping, or, if a more radical proceeding is essary, by injection or excision.

. **Diffuse Hydrocele of the Cord** is but rarely seen. It results from ffuse œdema of its cellular tissue, and presents on examination a form or sausage-shaped tumour, which extends along the cord a variable distance.

he term **Chylous Hydrocele** is applied to a distension of the tunica inalis with a chylous fluid, recognised by being milky in appear-e, and under the microscope seen to consist of a fatty emulsion. eral modes of origin have been suggested, but none are very sfactory. In one case under our care, a series of dilated lymphatics d with a similar fluid extended upwards from the testicle to the uinal canal.

Varicocele.—A varicose condition of the pampiniform plexus is ry commonly met with in young men, but seldom in those of vanced age, except when it has become chronic, or is due to dignant disease of the kidney (p. 1174). It usually occurs in lividuals with a lax and pendulous scrotum, and is often associated th masturbation, which induces abnormal vascularity of the testis. ıe fact that it sometimes develops in quite young boys suggests,

operation is conducted as follows: The pubic region ing been shaved and purified, an incision 1½ inches long is made he direction of the cord, with its centre a little below the rnal abdominal ring. The structures of the cord are raised on fingers, and the coverings divided, so as to expose the spermatic s at their upper end. Two main branches are usually found in situation, but occasionally there is only one. These are cleaned carefully isolated from the other structures of the cord, and a ure is applied to them at the external abdominal ring. The els are now clamped with a pair of Spencer Wells forceps w the ligature, and divided between it and the forceps. The

Fig. 466.—Large Varicocele in a Patient aged 35 years, who had used no Support for Many Years.

ver end, grasped by the forceps, is stripped downwards, so as to e the pampiniform plexus from the other elements of the cord, d the dissection can be carried nearly as far as the epididymis by wing the testicle up into the wound. The lower end of the veins ligatured in one or two portions, and divided. By this means the ole varicocele is removed. If the scrotum is pendulous, and the ticle hangs low, it may be advisable to raise it by tying the upper d lower ligatures together, care being taken not to pull them off so doing; perhaps it is wiser to introduce a suture through the ided ends of the veins above and below, which are purposely left g. The wound is then closed without a drainage-tube, and ssed as usual. The patient is kept in the recumbent posture for rtnight, until organization has occurred in the divided ends of the ns, and a firm cicatrix has formed. This method of treatment is initely superior to that often practised of exposing the veins in the otum, since a wound in the groin always heals much more readily an one in the scrotum; whilst it is easier to dissect the veins out

from above, where only one or two trunks exist. The venous return after the operation is maintained by the vein or veins running with the artery to the vas in the posterior portion of the cord. Occasionally, if the removal of veins has been too complete, a hydrocele develops subsequently, owing to the passive congestion of the testis. It is usually unnecessary to remove any scrotal integument, although it is often redundant; but after the wound is soundly healed, the dartos may be stimulated daily by brushing the scrotum with a clothes-brush.

Neuralgia of the Testis is characterized by the organ becoming exquisitely tender and painful, although apparently healthy. It usually occurs in young adults of nervous temperament, or in middle-aged gouty men. It is not uncommonly associated with a varicocele. The pain is usually paroxysmal in character, and very intractable. **Treatment** must be directed mainly to the general health, consisting in the administration of nerve tonics, such as iron and quinine, whilst locally sedatives, *e.g.*, belladonna and aconite, may be applied. It is also advisable that a suspender should be worn.

Atrophy of the Testis results from several causes: (i.) It may be due to a congenital arrest of development, as met with in displacement or late descent. (ii.) It is most frequently the consequence of inflammatory affections, either of the body or epididymis, owing to the cicatricial contraction caused thereby leading to compression of the vessels. It occasionally follows the metastatic orchitis of mumps, especially in adults, whilst it is also due to syphilitic disease. (iii.) It arises from impaired nutrition, as after the division of the spermatic arteries in operations for varicocele or hernia, or from compression of the cord by closing the inguinal canal too firmly in the operation for the radical cure of hernia. (iv.) Chronic congestion of the organ, as by a varicocele, may induce atrophy; whilst (v.) sexual excesses are also stated to lead to it. If unilateral, it is of comparatively little importance; but where both organs are affected, sterility is sure to result, and the patient, if previously young and healthy, is likely to become depressed in spirits and melancholic. This may be due in part to mental causes, but also in measure to the absence of seminal secretion, the reabsorption of which into the system is, according to Brown-Séquard, an important factor in the maintenance of a vigorous state of mind and body.

General Diagnosis of Scrotal Tumours.

When a patient presents himself for examination with a swelling in the scrotum, the surgeon has to decide whether it is a hernia, a hydrocele, a hæmatocele, a varicocele, or a solid enlargement of the testis, and, if the latter, of what nature. The first point to which attention is directed is the condition of the cord immediately below the external ring. If this is of normal size and consistency, hernia and diffuse hydrocele of the cord are thereby excluded, whilst the existence of a rounded tense swelling, moveable within the canal, but becoming fixed on holding the testis, indicates that an encysted

drocele of the cord is probably present. When, however, the rd is more or less masked, further examination speedily determines ether a hernia or a diffuse hydrocele or hæmatocele of the cord ists, since the former is often reducible, has an impulse on coughing, d is rounded or nodular in outline, and the latter are sausage-aped, always irreducible, and semi-fluctuating.

When the swelling is purely scrotal, inspection and manipulation ll at once decide if it is a varicocele, by its characteristic feel, by disappearance on assuming the recumbent posture, and filling ain from below on standing up. If the swelling is rounded in tline, the next point to be determined is whether it is solid or fluid. fluid, it is probably a hydrocele, or the early stage of a hæmato-le; the translucency of the former, and the sudden appearance and n-translucency of the latter, should suffice to demonstrate its ture. It is possible that the hydrocele is merely a secondary com-cation, and hence no final opinion should be given until it has been)ped, and the condition of the body of the testis investigated. If, wever, a solid mass exists in the scrotum, it is either a hæmato-e in its later stages, or some form of sarcocele, whether simple, philitic, tuberculous, or neoplastic. A *hæmatocele* is possibly recog-ed by its history, and by there being a fluid centre to the swelling, rounded by solidified tissue. *Chronic orchitis* and *syphilitic* enlarge-nt of the testis are so much alike as to render diagnosis always certain in the absence of a distinct syphilitic history; but if the elling is extremely hard, with a smooth and regular outline, with-t testicular sensation, limited to the body of the testis, and accom-nied by a hydrocele, it is probably syphilitic. *Tuberculous* disease, the other hand, occurs more frequently in younger individuals n does the syphilitic variety, whilst the epididymis is usually first acked, becoming nodulated, the cord is early implicated, hydrocele rare, suppuration is frequent, and testicular sensation remains till body of the testis is disorganized. *Tumours* always impart a tinct sense of weight to the hand, quite different to that noticed uberculous or syphilitic disease; if a simple tumour is present, it rounded, slow in growth, and the cord is unaffected. Malignant sease is characterized by rapid growth, more severe pain, and early plication of the structures of the cord and of the lumbar lymphatic ands. The enlargement of both testes is in favour of tubercle or philis rather than of malignant disease. A certain small number cases will remain where, in spite of every care, the nature of the ass is still a matter of doubt; in such the diagnosis cannot be tablished without puncture or an exploratory incision.

Whilst weighing carefully the local conditions, we must not omit oroughly to investigate and appreciate the general history and con-tion of the patient, his age, appearance, previous habits and ill-sses, etc. At the same time, an examination of the internal organs ould be made to ascertain, as far as possible, the existence or not concurrent disease, *e.g.*, tuberculous disease of the lungs or kidneys, secondary malignant deposits.

Castration is required for many different conditions, which have

been already described, *e.g.*, for malposition, tuberculous disease, old-standing hæmatoceles, and simple or malignant tumours. The operation is conducted as follows: The pubes and perineum having been previously shaved and purified, the surgeon, standing on the same side of the patient as the organ to be removed, makes an incision down to the testis. If large and adherent to the scrotal tissues, the incision must necessarily involve the scrotum, but wherever practicable it is wise to avoid the scrotal integuments, making the incision over the cord. It should always extend upwards as far as the external abdominal ring, so as to enable the structures of the cord to be divided high up, a most important matter in tuberculous and malignant disease; the inguinal canal can then also be closed, if necessary. The testis or tumour is enucleated from its surroundings, and the cord isolated and divided as high as possible, after transfixing and securely ligaturing it with silk. Some surgeons prefer to separate the tissues of the cord, and to take them up individually, but this is a matter of little importance. The stump should not be allowed to slip back into the canal until all bleeding has completely stopped, and it has been suggested that the cut end of the vas should be touched with pure carbolic acid as a precautionary measure. All bleeding points in the scrotum are now secured by ligature, and these may be numerous; the wound is closed by sutures, a drainage-tube being inserted in the scrotum, and by choice coming to the surface at the upper end of the wound, that is, as far from the perineum as possible.

In the performance of double castration, it is recommended to make two crescentic flaps from side to side, so as to include between them a portion of the scrotal integument, in order to reduce the subsequent redundancy of unnecessary tissue.

Affections of the Vesiculæ Seminales.

Acute Vesiculitis is not often met with, but sometimes arises, in association with prostatitis, as a complication of gonorrhœa. It is characterized by deep-seated pain in the perineum, together with irritability of the neck of the bladder and increasing frequency of micturition. Defæcation becomes painful, and on examination of the rectum the vesiculæ can be felt enlarged and tender. If suppuration ensues, an abscess forms, which usually bursts into the rectum, but sometimes into the bladder or peritoneal cavity. As a rule, the condition disappears *pari passu* with the gonorrhœa; but when suppuration has supervened, it is advisable to open the abscess by a deep incision through the perineum, guided by a finger in the rectum.

Subacute or **Chronic Vesiculitis** is not uncommon, the latter condition being often associated with prostatitis, and one of the most frequent causes of gleet. Seminal emissions and priapism may be caused by it, and the enlarged organ can be felt through the rectum. A good deal of pain, often referred to the back, is experienced. The treatment is the same as for chronic prostatitis.

Tuberculous Disease attacks the vesiculæ seminales as a result of extension from the testis along the vas, being almost always associated with similar disease of the prostate and base of the bladder. The organs can be felt enlarged, and if suppuration occurs, the abscess may burst into the rectum or bladder, or possibly into both, a recto-vesical fistula being thereby developed. It is possible to reach the vesiculæ through a semilunar incision in the perineum, displacing the rectum backwards, and the bladder and prostate forwards, or from behind by removing the coccyx and part of the sacrum, as in Kraske's operation. When exposed,

excision is sometimes possible, or an opening is made into them, and contents scooped out.

Affections of the Scrotum.

of the Scrotum.—Contusions and blows give rise to ecchymosis, which extensive as to warrant the term *hæmatoma scroti* which has been it.

wounds may affect the skin and subcutaneous tissues, or may lay open vaginalis, with or without protrusion of the testicle. All that is needed ases is to render the wound aseptic, and to deal with it on general . Considerable destruction of scrotal tissue may be repaired by trans- of flaps from the inguinal region, ifting according to Thiersch's

s of the Scrotum most commonly m extravasation of urine, for p. 1236. It may occasionally a other causes, and leads to stitutional disturbance, usually henic type, and often to con- sloughing; the testes may be hen the sloughs come away, or be involved in the same process. ral rule repair is very active in m.

of the Scrotum is usually due , being often associated with nasarca and ascites. It may siderable dimensions. *Acute in- œdema* of the scrotum is a term applied to erysipelas affecting , on account of the absence of red colour usually caused by tion. Considerable œdema is esent, and gangrene of the skin lt. As soon as the gangrene imited, it should be excised, and ns of the wound brought together by sutures, or allowed to heal by n.

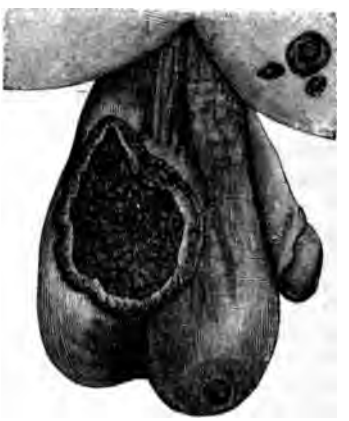


FIG. 467.—EPITHELIOMA SCROTI FOLLOWING PARAFFIN ECZEMA. (TILLMANNS.)

Fistulæ are usually due to the bursting of abscesses in connection with a (see Perineal Abscess).

of the Scrotum are often found in connection with tuberculous or disease of the testicle.

of the Scrotum is a troublesome affection, giving rise to great pruritus tion. It results from the presence of pediculi, but the more chronic ar amongst workers in tar and paraffin, and also in chimney-sweeps, to the constant irritation of the corrugated scrotal integument by dirty It is characterized by the presence of warty outgrowths, and not un- runs on to **epithelioma**, originating the condition known as *chimney- araffin cancer* (Fig. 467). The usual characteristics of such a new growth , and in some of the deeper cells particles of soot have been demonstrated. al glands are usually involved, but not till late, and the progress of slow. The only treatment which can be adopted is complete removal, caused thereby being closed or allowed to granulate.

hantiasis Scroti, see p. 361.

CHAPTER XLII.

SURGERY OF THE FEMALE GENITAL ORGANS.*

Affections of the Vulva.—Injuries to the External Genitalia may arise from direct violence, or during parturition from the forcible expulsion of the head. In the non-pregnant condition the results differ but little from other similar lesions, and require no special treatment or consideration. Occasionally a kick or a fall on a stick or paling may result in *laceration of the recto-vaginal septum*. The wound is usually contused, and the margins irregular, so that immediate suture is unlikely to succeed. The parts are therefore kept clean by frequent douches and allowed to granulate, and the loss of substance is in that way often made good; should a fistula persist, a plastic operation will be subsequently necessary. Of course, if the original injury is a clean incision, immediate operation to close the defect is desirable.

In the pregnant state or when large varicose veins are present, an injury to the vulva may result in serious hæmorrhage if there is an external wound, or in the formation of a large *hæmatoma*. The labium becomes much swollen and firm to the touch, owing to the coagulation of the blood; suppuration often follows, especially if the injury is associated with a superficial abrasion. **Treatment.**—If the hæmatoma should hinder parturition, it may be necessary to incise it at once and turn out the blood-clot. Under other circumstances it may be treated by the application of cooling lotions; but should it persist or if suppuration ensues, operation will be required; the cavity is opened, emptied and stuffed with gauze to ensure healing by granulation.

Varix of the vulva is not unfrequently associated with a similar condition in the legs, or may sometimes arise as a result of blocking of the external iliac vein, owing to the opening up of collateral branches. One or two veins may become enlarged, often running transversely across the Mons Veneris, or large bunches of veins may

* It is impossible in a work of this size to include more than a comparatively brief notice of the more important gynæcological conditions which encroach on the domain of the general surgeon. As a means of distinction we have considered that all vaginal operations, etc., are purely gynæcological, whilst those necessitating abdominal section belong as much to the general surgeon as to the gynæcologist. Vulval lesions, of course, may come under the care of either.

rm in the labia. Pregnancy usually aggravates this condition to an arming degree, and a very slight injury may determine a rupture the veins. **Treatment.**—If troublesome and causing much pruritus irritation, the veins may be excised under careful antiseptic ecautions.

Vulvitis, or inflammation of the lining membrane of the vestibule, due to uncleanliness, gonorrhœa, or to irritating discharges coming om above. It is characterized by injection of the mucous membrane, by itching or smarting pain, especially on walking, and a cretion of mucus or muco-pus, causing the labia to stick together. ie mucous follicles may become affected, and a localized abscess sult, situated either immediately beneath the mucous membrane in the substance of the labium. The *treatment* consists in the use warm and mild astringent or antiseptic lotions to purify the part ., lotio plumbi), sitting in hot water being most beneficial. At the ne time the patient is kept quiet, and the bowels are opened by a ine purge. When a follicular abscess forms, it should be incised ough the mucous membrane and its cavity stuffed with a small rtion of dressing. A labial abscess should be freely opened at y spot where it is tending to point, and the cavity packed with ize to ensure healing from the bottom.

Vaginitis may be secondary to vulvitis, or associated with an lammatory affection of the uterus. As a primary lesion it is st commonly due to injury, such as the injection of too hot water, the presence of a foreign body, *e.g.*, a badly-fitting and retained sary, or awkward or violent coitus. Vaginitis is not generally iarked feature in gonorrhœa. The symptoms are a sense of heat l pain, frequent and painful micturition, and a free muco-purulent corrhœa. Complications may arise from extension upwards to uterus and tubes. **Treatment** consists in warm soothing inions in acute cases, together with hot hip-baths; in the more onic types astringent injections are required.

Cysts of the Labia are occasionally seen, being due to the blocking f the duct of a mucous follicle, or of the more specialized vulvoaginal glands (glands of Bartholin); they may attain considerable imensions, and must be freely dissected out if causing any inconenience.

Various other tumours of the vulva occur, *e.g.*, elephantiasis, ithelioma, etc., but have no special peculiarities.

Affections of the Round Ligament are not very uncommon. Nonobliteration of the canal of Nuck leads to the appearance of a *ngenital inguinal hernia*, which is very frequent in girls and young married women. In the operation required for its cure the round gament is included in the ligature which encircles the neck of the c. A *hydrocele* of the round ligament is due to a partial obliteration the same structure, the patent portion becoming distended with a rous exudation. It presents as a tense, rounded swelling just low the external abdominal ring or in the inguinal canal, and is ated by dissecting it away. We have also met with a case of

locular hydrocele, in which an external cavity communicated with large pelvic collection of fluid enclosed in a serous membrane. *umours* of the round ligament are unusual, but occur in the form of mphangioma and fibro-myoma. An interesting instance of the tter was seen in a woman who was also the subject of uterine bro-myomata necessitating hysterectomy. The tumour of the und ligament was as large as an orange.

Uterine Displacements.—The maintenance of the uterus in its rmal position of slight anteversion is due to the associated influence many diverse factors. Displacements are caused by many lapses om the normal condition, *e.g.*, lack of support, as by rupture of the rineum, increased pressure from above, increased weight of the terus, as from subinvolution after pregnancy, chronic inflammation the presence of tumours, the traction of adhesions resulting from lvic cellulitis, etc. The most common displacements are forwards, nstituting anteversion or anteflexion; backwards, in the form of troversion or retroflexion; and downwards, giving rise to prolapse procidentia.

It is unnecessary to enter into the symptoms and ordinary treatent of these conditions; but the operative treatment of them quires notice.

Anterior displacements require no external operative treatment.

Posterior displacements are not unfrequently dealt with by erations through the anterior abdominal wall. Two chief methods e employed, viz., shortening the round ligaments and hysteropexy. *hortening of the round ligaments* can be undertaken as an extra- or as intra-peritoneal procedure. (i.) Alexander's operation is extra-ritoneal, and suitable only for uncomplicated cases. The inguinal nal on each side is exposed and the external oblique slit up; the und ligament is identified, isolated, drawn taut, and the slack portion t away; the posterior end is then fixed in the canal by sutures, which so serve to close it; the external oblique is also carefully sutured. i.) In the intra-abdominal operation a complete investigation of e pelvic viscera is possible. A small median incision is made; e round ligament on either side is isolated, doubled over, and itched to itself so as to remove all slackness. This latter operaon is probably much the more satisfactory of the two. Of course, e additional use of a suitable pessary may be desirable.

Hysteropexy, or the fixation of the uterus to the anterior abdominal all, is a procedure that must be cautiously undertaken in married atients who have not reached the climacteric. An incision 2 or inches in length is made immediately above the symphysis, and e fundus uteri is drawn forwards by a volsellum. Three silkworm t stitches are inserted through the abdominal parietes and perito-eum, and also through the body of the uterus just posterior to its vis. The stitches should include about $\frac{3}{4}$ inch of the uterine wall their grasp, and go about $\frac{1}{8}$ inch deep. On drawing them tight, e uterus is fixed forwards against the abdominal wall and contracts lhesions. In some cases it may be desirable to scarify the uterine

all before tying the stitches, so as the better to determine adhesions. s a general rule the adhesions stretch somewhat, and hence allow certain degree of play, but without the likelihood of a return of ie displacement.

Prolapse of the Uterus is most commonly associated with a ıptured perineum and chronic metritis. The anterior vaginal wall ten gives way first and brings down the bladder, causing consider- ıle dysuria or vesical irritation; and then the uterus itself

IG. 468.—INCISION FOR REPAIRING RUPTURED PERINEUM.

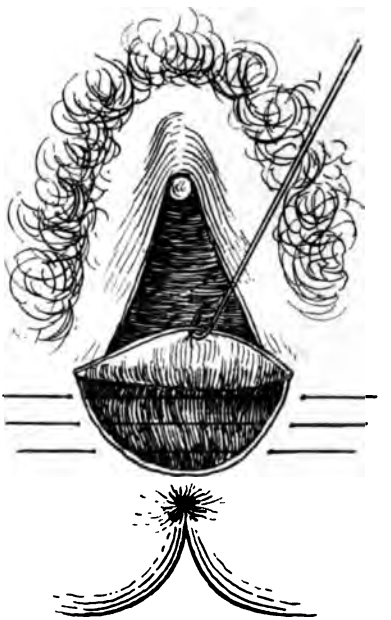
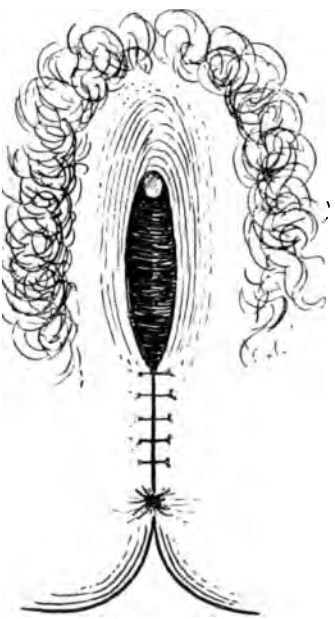


FIG. 469.—VAGINAL FLAP DISSECTED UP FROM RECTO-VAGINAL SEPTUM AND DRAWN FORWARDS.

Some of the sutures are introduced.

scends, and may even protrude from the vulva, the vagina being rned inside out, and its walls becoming dry like skin, and perhaps cerated from persistent irritation. **Treatment** varies according to e condition present and with the causes. The uterus, if enlarged id inflamed, may need to be curetted so as to diminish its bulk and sight. The perineum, if defective, must be repaired by one of the any forms of perineoplasty now in vogue. Possibly the introduc- n of a suitable pessary may suffice to keep the uterus in place for sufficient time to allow the uterine supports to regain their tone. some cases hysteropexy will be indicated, but in the worst forms ginal hysterectomy, combined with some operation to diminish e size of the vaginal canal, may be required.

The operation for *repairing a ruptured perineum* necessarily varies th the extent and completeness of the tear. Obstetricians should ways endeavour to stitch up these ruptures immediately after)our, as the parts are then very insensitive, owing to the stretching ıich they have suffered, and patients are very loth to undergo a :ondary operation soon after. The plan usually adopted for nedying a defect which does not quite extend to the anus is indi- ted in Figs. 468-470. An incision is made skirting the posterior vulval margin, and extending forwards on either side to the terminations of the nymphæ. By deepening this the posterior vaginal wall can be separated from the rectum, great care being taken not to encroach on either cavity, and the flap thus produced is drawn forwards. The wound is then stitched up transversely, and an effective perineal body produced. A more extensive intra-vaginal operation is needed when the rent involves the anal orifice.



3. 470.—Operation for Repairing Ruptured Perineum completed.

Uterine Tumours.

Fibro-myomata are by no means uncommon, developing during sexual activity, and causing symptoms partly from their location in the uterus, partly from the size which they may attain. Any part of the uterus may be affected primarily, but they generally originate in the substance of the wall, and that usually the posterior wall; if they remain in this rela- ın, they are known as *interstitial* or *intramural* fibroids (Fig. 471, 1). 'hen they are situated near the inner or outer uterine wall they ay project either into the uterine or peritoneal cavities, constituting e *submucous* (2) and *subserous* (3) fibroids. Occasionally they become dunculated, and then a *fibroid polypus* of the uterus may develop, ıd project through the os into the vagina, where it may undergo rangulation or torsion, and may slough away or become acutely flamed. A pedunculated subserous fibroid may similarly become risted or inflamed, and then may either slough, or may gain lhesions elsewhere, *e.g.*, to the omentum, and finally become parated from the uterus.

The *actual structure* of these tumours varies slightly, but they are l more or less of a fibro-myomatous nature, *i.e.*, they consist of

uscle fibres similar to those of the uterus, with a varying amount fibrous stroma and bloodvessels. Occasionally they are very ırd and not specially vascular; in other cases they are more soft ıd more vascular, and then usually grow more quickly. They are rrounded by a capsule of varying density, which is often the seat many enlarged veins, and if these are ulcerated into, considerable æmorrhage follows. The uterus generally becomes hyperæmic ınd enlarged, and the mucous nembrane thickened; not unrequently endometritis is present, ınd the inflammation may spread ıp to the tubes, causing pyosalpinx.

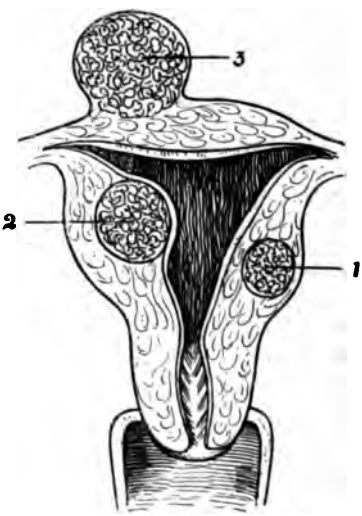


FIG. 471.—DIAGRAM OF UTERUS WITH FIBRO-MYOMATA.

1, Interstitial fibroid; 2, submucous fibroid; 3, subserous fibroid.

Various secondary changes may ɔccur in uterine fibroids. They nay become *œdematous*, or undergo *ystic* degeneration, as a result ɔf defective nutrition, and that generally in young people; fibro-:ystic disease of the uterus is :hereby determined. Occasionally n old women, where the evolution ɔf the growth has long ceased, *alcareous degeneration* occurs, and he growth is converted into a tony mass. *Inflammation and yogenic infection*, with perhaps ıbscess formation, may follow ıbrasion of the mucous membrane vith a sound, and *sloughing* of the growth may result either from ın inflammatory attack or from lefective blood-supply. It is ɔossible that *sarcoma* may supervene in some few cases, but the ssociation is not yet absolutely proven.

The **Symptoms** vary much in different cases, but are mainly those ıf hæmorrhage and pressure. *Hæmorrhage* occurs either as a proɔngation of the normal menstrual periods (menorrhagia), or as a hronic and persistent effusion of blood (metrorrhagia). It may be bsent in subserous and interstitial fibroids, and is most marked in he submucous variety, in which the endometrium is congested and ucculent. The amount of blood lost may drain the patient, who ɔoks anæmic and dehydrated. There may be but little *pain* in the ubserous variety, unless the growth becomes twisted or impacted in he pelvis. When the tumour projects upwards into the abdomen, othing but a sense of weight is experienced unless the size is so great s to encroach seriously on the viscera. When the growth is mainly elvic, and especially when a fibroid of the cervix extends sideways ıto the broad ligament, or when impaction occurs, the symptoms may

very distressing. Vesical irritability may be very marked, and cturition may be painful and difficult. Tenesmus or constipation ıy arise from pressure on the rectum; hydronephrosis, when the ɛters are compressed; and severe neuralgic pain down the leg, ɔuld the pelvic nerves be encroached on. The presence of a poly- ıd submucous growth is likely to cause violent expulsive contrac- n of the uterus.

The **Diagnosis** is made by palpation, digital examination, and the ɛ of the sound. Bimanual examination should reveal the size and ıpe of the uterus, and much useful information can often be ob- ned by a combined vaginal and rectal examination. The sound l determine the increased length of the uterine canal, which is often addition twisted.

The **Prognosis** has to be considered carefully in every case before ermining for or against operative treatment. The majority of the es improve at the menopause, the growth shrinking and the morrhage ceasing; exceptions to this rule are, however, not un- ɔwn. It is therefore obvious that if the patient is approaching climacteric and the symptoms are not grave, it may be advisable ıwait for that event. On the other hand, if the condition occurs ı young woman, and especially if the hæmorrhage is sufficiently ere to necessitate prolonged rest and more or less chronic in- idism, operation is certainly desirable. Of course, the existence severe hæmorrhage, or of symptoms of pelvic pressure, would at ages justify operation.

Treatment.—If the symptoms are not such as to warrant operation, that is required is that the patient should rest at the menstrual iods, and that ergot and iron should be administered if necessary.

Operative Treatment consists in either the enucleation of the tumour the extirpation of the uterus, and the removal of the ovaries and ıes.

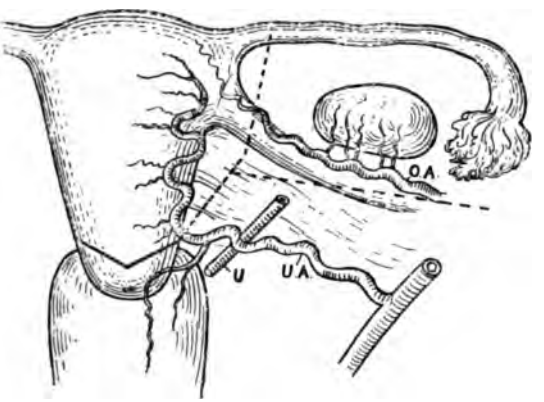
1) **Myomectomy**, or the enucleation and removal of the tumour ırt from the uterus, is only suitable under special circumstances. hen the growth projects into the uterus or vagina as a polypus, the ginal route may be adopted; the cervix is dilated if need be, and ɛr incising the mucous membrane, the growth can be enucleated the finger. A subserous fibro-myoma can similarly be removed hout difficulty if it be thought desirable. Not unfrequently this ıdition is met with in laparotomies for other conditions, and the geon may think it desirable to remove the growth. A longitudinal ision down to the capsule and a sweep round of the finger usually fices to enucleate the tumour, and that with very little bleeding. ɣo or three deep stitches may be introduced into the uterine sub- nce, and the peritoneum adjusted and apposed by superficial ches. No drainage is required as a rule.

2) **Abdominal Hysterectomy** for fibroids is a most successful pro- lure. It may suffice to remove the organ through or above the vix (supra-vaginal hysterectomy), or it may be needful to include cervix in the mass that is removed (pan-hysterectomy). The

cedure is identical up to a certain point, but the latter operation ather the longer, and the dangers are a little greater.

The patient must be carefully prepared as for any other abdominal ration (p. 960), but in addition the pubes and vulva must be ved and thoroughly purified; the vagina should be douched for ıe days previously, and an antiseptic dressing worn, and if need the uterine canal should be curetted and disinfected with some ⁄erful antiseptic.

After anæsthesia has been induced, the Trendelenburg position is ⅄opted, and an incision of suitable length made in the median line. 'he parts are then carefully explored, and if no adhesions exist,



G. 472.—Diagram of Uterus, Vagina, and Broad Ligament, seen from in Front.

.A., Ovarian artery; U.A., uterine artery; U., ureter. The dotted lines represent the division of the broad ligament in hysterectomy according to whether or not the ovary is removed. The continuous dark lines crossing the uterus indicate the incisions through the uterine substance in supra-vaginal hysterectomy.

ı abdominal cloth is packed in over the intestines in order to rotect and keep them from exposure and injury. If adhesions to nentum or gut are present, they must be carefully divided; it is, : course, most desirable that a complete peritoneal envelope ıould be secured for any adherent organs; omental grafts may ɜ sometimes useful in this direction. The uterus is now lifted up ıd drawn into the incision, and for this purpose Doyen's myoma :rew is most useful.

The broad ligaments are then examined, and a decision made ; to whether or not the ovaries and tubes are to be saved. It certainly desirable that in a young woman an effort should be ade to retain at any rate one ovary, thereby avoiding the nervous 'mptoms often determined by an acute artificial menopause. The ıes of section of the broad ligament under these two conditions are ıdicated diagrammatically in Fig. 472.

A pedicle needle carrying a sufficient length of well-boiled silk is rried through the round ligament so as to secure the ovarian artery d veins, and tied as far away from the uterus as possible; a broad ament clamp may then be placed in position close to the uterus as to prevent venous regurgitation, and the broad ligament is ided halfway down. It is often possible and desirable to pick up e divided end of the ovarian artery on the face of this section and ure it separately, whilst the little artery which accompanies the nd ligament should also be carefully secured. The ovarian artery the other side is next dealt with in a similar fashion. A transrse cut is now made across the front of the uterus, involving merely e serous membrane, and connecting the two ends of the incisions the broad ligaments; the peritoneum below this transverse cut detached, together with the bladder, from the cervix, and the intraamentary space is thereby opened up on either side. In this will found the uterine vessels, and it may be possible to see and late the uterine artery before securing it by ligature. Care must taken in this part of the operation to keep close to the uterus, as e ureter comes forwards from behind under the uterine artery to ch the bladder, lying about the level of the os internum. The erine vessels are in this way carefully secured and divided.

The uterus is now merely held by the connection between the gina and cervix, and the peritoneal reflection in Douglas's pouch. a supra-vaginal operation will suffice, the surgeon cuts across the ck of the uterus in such a way as to fashion two flaps, and ally the peritoneum behind is also divided. A few small vessels ll probably need to be secured on the face of the uterine stump. is having been effected, the uterine flaps are stitched carefully gether so as to bury the open cervical canal; the uterine stump is en covered in by uniting the divided portions of peritoneum. This e of sutures is carried up on either side so as to secure the two ers of the broad ligament; the final result is that the pelvic floor covered in by a continuous layer of peritoneum, showing a closed ision which runs transversely from one side to the other. The ual peritoneal toilette follows, and the abdomen is generally closed tirely, no drainage being required.

When the fibroid tumours involve the cervix, it may be necessary perform pan-hysterectomy. The operation follows along the lines licated above, up to the securing of the uterine vessels. It is then visable to open into the posterior vaginal cul-de-sac, and enucleate e cervix from its surroundings from behind forwards, keeping very ar to the uterus at the sides so as to avoid the ureters, and keeping ar of the bladder in front. Several vessels derived from the ginal arteries will require to be secured in this proceeding. The ound in the pelvic floor is closed much in the same way as before, t not so completely as regards the vaginal walls, a small lampck drain of iodoform gauze being introduced between them. The ritoneum is sutured continuously over the gauze, and up on either le to the upper extremity of the broad ligament.

In either case a pad of antiseptic dressing is maintained over the ılva for a time, and in pan-hysterectomy it is advisable to douche e vagina daily. The gauze packing is removed on the third day, ıd another strip introduced. The results of this operation are most atisfactory, and the death-rate comparatively small.

(3) **Double Salpingo-oöphorectomy** (removal of ovaries and tubes) ras at one time much practised in the treatment of uterine fibroids, ınd certainly had the effect of checking hæmorrhage and diminishing heir growth by determining an artificial menopause. At the same ime, the patient is not relieved of the incubus of the growth, and ience the operation is now but seldom employed, except as a part of ı complete hysterectomy.

Sarcoma of the Uterus is not of very common occurrence. It may e a secondary development following on fibro-myomata, or may be rimary. In most cases it occurs as a solid, firm tumour, consisting f spindle cells, but more vascular and a little softer than the majority f fibroids; in others it is of a softer consistency, and may be associ- ted with myxomatous development. It almost always involves he body of the organ, the cervix being unaffected; and it may ither attack the mucous membrane primarily as a diffuse infiltra- ion, or constitutes a more localized growth in the muscular tissue. Secondary deposits occur in the vagina and elsewhere, and the case uns a more rapid course than a simple fibroid, although the ymptoms are much of the same type. There is, however, more ischarge from the vagina, which may contain débris of the growth, ınd becomes somewhat offensive. **Treatment** consists in pan- ıysterectomy.

Carcinoma of the Uterus is the most common form of cancer in the emale, accounting for over 30 per cent. of the deaths from this isease. It follows the usual rule as to age, being uncommon under hirty years, and most frequently seen between the ages of forty ınd fifty. It generally occurs in multiparæ, and is probably ssociated with lacerations of the cervix and inflammatory erosions lependent thereon. The site of origin is usually the cervix, the ody being comparatively seldom affected primarily.

Cancer of the cervix starts (i.) as a nodular overgrowth of the lands imbedded in its substance; (ii.) as an epithelioma of the aginal portion, projecting into that passage as a malignant papil- oma; or (iii.) as a diffuse affection of the cervical epithelium and its lands, and hence is most frequently of a columnar-celled type. In ll these cervical forms the vagina is early affected; the disease preads more slowly up towards the body of the uterus. The rrangement of vessels and lymphatics will explain the fact that nvasion of the broad ligaments is early; these structures become nfiltrated and rigid, fixing the uterus, and pressure phenomena upon he rectum, bladder, or pelvic vessels and nerves, will sooner or later e manifested. Destructive ulceration follows, and the bladder or ectum may be laid open, and empty their contents into the vagina, hich in the worst cases becomes an evil-smelling cloaca. Adhesive

ammation serves to protect the peritoneal cavity, which is not
en opened up.

Carcinoma of the body of the uterus starts in the mucous mem-
ne and its glands, and rapidly disseminates and infiltrates the
ole cavity; it also is of a columnar-celled type. The whole
an may become hollowed out by ulceration, constituting a slough-
cavity from which an abundant hæmorrhagic discharge escapes.
n all cases lymphatic dissemination follows, involving the pelvic
nds first, and later on the iliac, and possibly even the inguinal.
mpression of the ureters may cause hydronephrosis; the iliac
sels may be compressed and lead to œdema of the legs, and pul-
nary embolus secondary to venous thrombosis has been known
ause death. General dissemination to the viscera is not common.

The chief **Symptoms** of uterine cancer are pain, hæmorrhage, and
offensive discharge. Pain is unfortunately not an early manifesta-
n in most cases, and hence the disease has often gained a good
d before the patient comes under observation. As soon as the
ly of the organ is attacked, or the extra-uterine cellular tissue, it
gins to trouble the patient; it is of an aching, gnawing, or boring
racter, and in the later stages may be so appalling in its severity
to necessitate the injection of huge doses of morphia. As a general
e, it is most marked when there is comparatively little destructive
eration. Referred and sympathetic pains in back, breasts, and
s are also much complained of. The hæmorrhage may at first be
rely an exaggeration of normal menstrual periods, but later on the
s of blood is often continuous and may be associated with horribly
nsive muco-pus and cancerous débris. The appearance of a
morrhagic discharge after the menopause should always determine
areful local examination of the pelvic viscera. Loss of flesh,
ility, and the ordinary phenomena of a cancerous cachexia, are
dually developed, and to these may be added special symptoms
e to implication of the bladder and bowel.

On *vaginal examination* the physical signs corresponding to the
e of disease make themselves evident. There may be merely a
lular thickening of the cervix; or an ulcerating papillomatous
ss, like a cauliflower, may project into the vagina, invading the
lls of this tube; or the finger may pass through the open os into
agged hollow cavity lined by an ulcerating mass of new growth.
e most careful attention must be given as to the lateral extension
the growth into the broad ligament, whether the uterus is mobile
fixed, and whether the vaginal wall is much involved, as it is
on these facts that the possibility or not of operation depends.
is useless to attempt removal when the broad ligaments are
lly invaded, or if the vaginal wall is extensively implicated, or
uterus firmly fixed to bladder or rectum.

In early doubtful cases where the os is ulcerated to a slight extent,
portion of the growth should be snipped away, and submitted to
croscopical examination.

Radical Treatment is only practicable when the disease has not

extended too far. Formerly gynæcologists used to practise amputation of the cervix when the disease was apparently limited to this region. In the light of modern pathology such a procedure is unscientific and insufficient, and clinical experience has shown that the only operation which should be considered is complete hysterectomy.

Hysterectomy for carcinoma uteri may be performed by the vaginal route or through the abdomen. (1) The *vaginal* operation is possibly a little safer, but has the objections that the broad ligaments cannot be dealt with quite so satisfactorily, and that should adhesions exist it will be difficult or impossible to deal with them. However, in simple early cases it will suffice, and, indeed, when the disease is so extensive as to need more than a vaginal procedure, it has probably gone so far as to be practically inoperable. For details of this operation, gynæcological text-books must be consulted. (2) *Abdominal* hysterectomy may be occasionally required, but operations which include removal of pelvic glands and extensive dissections will probably do little good, and may, indeed, aggravate the trouble by opening up fresh planes of tissue to infection. In any case the whole uterus must be removed, and it is advisable to thoroughly curette and purify the os and uterine cavity before commencing. (3) A combined vaginal and abdominal operation is sometimes undertaken when the disease has attacked the vaginal wall beyond the margins of the cervix. The greatest care must be taken not to injure the bladder or rectum, and not to divide or ligature the ureters.

Palliative Treatment in inoperable cases consists in staying the hæmorrhage, keeping the parts as free from sepsis as possible, and combating pain by morphia. In some cases it may be permissible to curette the diseased structures, thereby removing protuberant masses which interfere with the escape of the discharge.

Finally, a word must be added to emphasize the fact that the constant association of this disease with a torn and eroded os suggests the possibility of *prevention* by attending to such lesions and not allowing them to persist indefinitely without treatment.

Chorio-epithelioma (*Syn.*: **Deciduoma malignum**, **Syncytioma maligna**, etc.) is an interesting condition to which considerable attention has been directed of late. It consists of an overgrowth of the chorionic villi, which constitute a soft bleeding tumour, invading and thinning the uterine wall, and insinuating itself into the venous channels, so that general dissemination of the growth is an early manifestation, the lungs being usually involved first. The growth is a soft, flocculent, papillomatous-looking mass, involving the body of the uterus, and not unfrequently the fundus, and bearing a close resemblance in structure and physical characters to a vesicular mole; in fact, it may be looked on as a malignant form of this structure. The characteristic histological feature is the presence of large syncytial cells derived from the outer layers of the chorionic villi, which appear as masses of protoplasm, containing many dark nuclei; in addition to these are many smaller cells, irregular in shape, unusually rich in glycogen, and in which division by karyokinesis is the rule. It is unusual to be able to demonstrate typical chorionic villi in the mass, but the peculiar cells are exactly similar in nature to those which occur in the villi. Ovarian changes are not unfrequently observed, in the shape of multiple cysts, due to degeneration of the corpora lutea. The *clinical* features of a chorio-epithelioma are fairly characteristic. Occasionally the disease follows a normal pregnancy, and is apparently due to the

istence of a portion of the placental tissue, which takes on malignant action ıis peculiar type. In the great majority of cases, however, it is preceded by scarriage at a fairly early date, and perhaps a vesicular mole of some size is ɔved. The hæmorrhagic discharge does not cease, but continues and may ıme exaggerated. Retention of placental tissue is usually diagnosed, and as le the uterus is curetted; if on microscopic examination of the scrapings the ɔacteristic cells of a chorio-epithelioma are found, no delay is permissible, but uterus must be removed at once. Should the case be left, the hæmorrhagic harge increases, the uterus becomes enlarged, and evidences of secondary ɔsits appear, especially in the lungs. The nature of this growth is very gnant, and the patient quickly succumbs. *Treatment* consists in abdominal erectomy, which should include the ovaries, and if the case is taken before ɜmination has occurred, there is good hope of success.

Affections of the Fallopian Tubes.

yosalpinx, or an accumulation of pus in the Fallopian tube, is result of infection of its lining walls either with gonococci (the

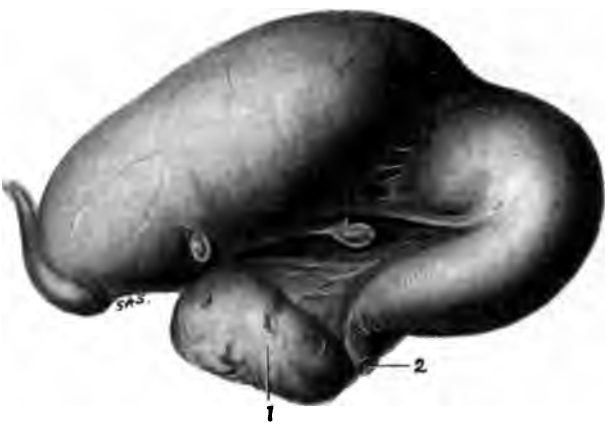


FIG. 473.—PYOSALPINX, SHOWING THE FALLOPIAN TUBE BENT OVER ON ITSELF. (KING'S COLLEGE HOSPITAL MUSEUM.)

1, Ovary; 2, uterine end of tube.

ımonest cause), or with pyogenic organisms spreading from a ɪic uterus after a miscarriage or confinement, or occasionally with tubercle bacillus. The process is usually chronic or subacute; ɪ should commence acutely, the symptoms are so blended with ɜe of the accompanying uterine or peritoneal inflammation as to ɜcarcely distinguishable. Both tubes are usually affected.

The inflammation, whether acute or chronic, usually results in ɔcking, and perhaps complete and permanent closure, of both ends the tube; the abdominal ostium may be closed by fibrin or by adhesion of the fimbriated extremity to surrounding viscera. ɪtension of the tube follows, and it frequently becomes elongated l tortuous (Fig. 473); it may contain a considerable quantity of ɪ, which, though containing organisms at first, may in time ɔme sterile, the germs dying out. The distended tubes gain

lhesions to surrounding parts as a result of plastic peritonitis, and
ıe abscess may burst either into the vagina, into one of the sur-
ıunding viscera (bladder, rectum, or small intestine), or into the
ıneral peritoneal cavity.

Clinical History.—In the *acute* stage, which is occasionally seen in
ɔnorrhœal and septic cases, the symptoms are practically those of
elvic peritonitis. The patient lies in bed with the knees drawn up;
the temperature is raised, and there may be one or more rigors; the
lower part of the abdomen is intensely tender, and vaginal examina-
tion reveals little but a generalized painful rigidity and infiltration
of all the parts. Under suitable treatment these acute phenomena
gradually subside, and the patient then begins to manifest the signs
of a *chronic* salpingitis, which in the majority of cases constitute the
initial symptoms. Pain is perhaps the chief manifestation, and this
is sometimes of a continuous dragging type, referred to the back and
increased on any exertion, or it may only be noticed to any extent
at the periods. Not unfrequently the patient is laid up for a week or
ten days at a time with these phenomena. If many adhesions are
present, micturition and defæcation may also be very painful. The
patient is unable to take much exercise, and may walk in a peculiarly
cautious manner, bending forwards so as to relax the abdominal
muscles and possibly guarding the lower abdomen with her hands.
All these symptoms are increased at the menstrual periods, which
ure profuse and prolonged, and accompanied by some rise of tem-
ɔerature. When a well-marked collection of pus is present, a hectic
ype of temperature may persist, and the patient shows signs of
ieptic poisoning. The bursting of the abscess into the vagina or one
of the viscera may cure the case, if a sufficient exit to the pus is
hereby provided. Vaginal examination demonstrates the enlarged
ınd tender tubes; the uterus itself loses some or all of its mobility,
ınd the vaginal vault may feel hard and rigid.

Treatment in the acute cases consists of rest in bed, fomentations
o the abdomen and hot vaginal douches, together with opium, if
ieed be, for the pain. In the great majority of cases, which are
hronic, the only treatment is removal of the tube and its contained
ıus. This may be a simple procedure, or an operation of the greatest
ifficulty, according to the number and nature of the adhesions
resent. It must be remembered that, although the pus in an
ld-standing case is likely to be sterile, one cannot rely on this
ccurrence, and hence every precaution must be taken to guard
gainst infection. It may be possible in some cases to save one
r both ovaries, and this is certainly desirable in order to protect
ıe patient from the discomforts of an acute menopause. In a
ıw favourable cases the pus can be reached through the vaginal
ault, and an intra-peritoneal operation is thereby avoided; but the
ıdications must be very clear and precise before this method of
pproach is adopted.

Hydrosalpinx is a condition in which the Fallopian tube is distended
ith a mucoid secretion, due to the existence of a chronic inflamma-

n, which has extended from the uterus, and led to the closure of
: abdominal and vaginal openings of the tube. A collection of con-
erable size may result, and needs to be dealt with by laparotomy.
Tubal Gestation is a condition in which the impregnated ovum
nmences to develop in the Fallopian tube instead of in the uterus.
e causes of this condition are quite unknown, but it may be due
a kink or twist of the tube, whereby the onward passage of the
ım is prevented. Ectopic gestation also occurs within the peri-
ıeal cavity or in connection with the ovary, but these conditions
: always looked on as secondary to a primary tubal gestation, the
:us having escaped from the tube. Any part of the tube may be
ɛcted, and hence three forms are described, viz., (1) the interstitial
tubo-uterine, where the growth encroaches on the uterine wall;
the true tubal; and (3) the tubo-ovarian or infundibular, where
: outer end of the tube is affected.

The muscular wall of the tube stretches and at first becomes
pertrophied; the mucous lining is turgid and congested, and
nsformed into a decidual membrane. In time the muscle fibres
appear and are replaced by fibrous tissue, and at the placental
ɛ atrophy occurs, so that sooner or later rupture of the tube
lows, and then the ovum either escapes into the abdomen or into
: substance of the broad ligament, and may die or continue its
velopment, the placenta possibly gaining a fresh attachment to
estines or other structures. Concurrently with these changes in
: tube, the uterus enlarges and becomes lined by a decidual mem-
ıne, but is relatively much smaller than usual; at five months it
a third smaller than in an intra-uterine pregnancy, and at full
m is about 4 to 6 inches long. Not unfrequently the rupture of
:ubal gestation is accompanied by the discharge of a complete
:t of the uterus, from which a lochial secretion escapes for a time,
l which undergoes involution.

The **clinical history** of an ectopic gestation varies very much in
ferent cases. The general signs of pregnancy are present, but
.y not be quite typical; the breasts are enlarged; vomiting may
:ur; but the menses are not always completely stopped. Examina-
n in the early stages might indicate the presence of a well defined
ıveable mass on one side of the uterus, if the gestation be un-
ɔtured.

In the early months the great danger is that of *rupture* of the tube,
l possibly death from hæmorrhage. Two forms are described:
1. **Primary Intra-peritoneal Rupture**, which usually occurs about
: sixth to the eighth week. The tube gives way before the in-
:asing tension of the ovum, and looks almost as if torn in half.
vere hæmorrhage follows, and the patient either succumbs, or
:overs to suffer, perhaps, from a similar condition a few days later.
a few cases the ovum regains a vascular connection in the
lomen and continues its development, but generally the pregnancy
nes to an end and the ovum dies. The *symptoms* are alarming in
: extreme. The patient is seized with severe cutting intra-

abdominal pain which is referred to the pelvis, and becomes white, faint, and collapsed. The lower part of the abdomen is exquisitely tender, and the muscles are held rigid and tense. The actual presence of blood in the peritoneal cavity can rarely be demonstrated, but the amount lost is often very great. If the patient survives, she is left in a feeble condition, and often suffers from pyrexia for some days, whilst the pain gradually diminishes. A recurrence of the bleeding may bring the patient into the direst peril; but if it does not recur, absorption commences and may progress uninterruptedly, or a pelvic hæmatocele may result, and this may persist indefinitely or undergo suppurative changes and require operation.

2. **Primary Extra-peritoneal Rupture** occurs when the chief development has been downwards and inwards between the layers of the broad ligament. The catastrophe is in these cases somewhat later than in the former class, rupture being delayed sometimes till the seventh to the twelfth week. The loss of blood is necessarily not so great, and the general symptoms are less severe. On vaginal examination the blood tumour can probably be detected by the side of the uterus. The ovum usually dies, and absorption may follow; but not uncommonly sepsis supervenes and an abscess forms; in other cases a secondary rupture into the peritoneal cavity follows, being associated with the ordinary symptoms of this condition.

Comparatively few ectopic pregnancies continue *after the fourth month*, but should the ovum escape the earlier dangers that surround it, s development may continue either in the tube (very rare) or in the bdominal cavity. The usual phenomena of pregnancy are present, ut with modifications. The breasts are less full than usual; the ıovements of the child under the abdominal wall may be too obvious › the naked eye; the abdomen is asymmetrically enlarged, and the ıg axis may even be transverse; palpation of the fœtus may be ıduly easy, and the placental souffle exaggerated or misplaced. t full term, or possibly a month or two before it, a form of spurious bour occurs, followed usually by the death of the fœtus. The ›dominal swelling diminishes in size, and the uterus undergoes in-ılution with a lochial discharge. The fœtus is either encapsuled, d may be either mummified, calcified (then constituting a *litho-lion*), or transformed into adipocere; suppuration sometimes ensues, d the disintegrated fœtus may find its way out through abscesses ıich burst into the hollow viscera or externally.

Treatment of a Ruptured Tubal Gestation.—In these cases the nger to the patient is that of hæmorrhage, and it is obvious that › rules that guide us elsewhere apply here—viz., that the bleeding nt should be exposed and the torn vessels secured. Owing to the t that the hæmorrhage is concealed, it is possible for the patient pass into such a condition of collapse as to render operative treat-nt almost impracticable. In such cases it may be feasible to ›rove her condition by the infusion of salt solution so as to justify ration. In other cases where the patient has had one attack of

emorrhage from which she is recovering, the question of operation quite open to discussion: on the one hand are the facts that no rther trouble need arise, and that the hæmatocele may be absorbed; the other hand the hæmorrhage may recur, or the hæmatocele may ppurate. It is probable that operation in all cases is perfectly und advice, especially as one cannot be always certain that the rum is dead (although the passage of a cast of the uterus suggests , and it is desirable that it should not continue its development in e peritoneal cavity. In careful aseptic hands the risks of operation e very small. It goes almost without saying that if a diagnosis tubal gestation is made prior to rupture, the tube should be at ice removed.

Operation for *intra-peritoneal* rupture must not be delayed; ssibly it may be wise to commence intravenous infusion before ening the abdomen, and to allow an assistant to continue the ocess. The patient is placed in the Trendelenburg position; a edian incision is made above the pubes; an abundant escape of ood and clots is likely to follow, but the hand is thrust firmly down as to distinguish the uterus, and thence passes to the ruptured be, which must be grasped by the uterine attachment and a emostatic clamp at once applied; the other end is then sought . Both portions are removed, and the bases securely ligatured. ie intra-peritoneal clots may be cleansed away or left according to e condition of the patient, and the abdomen either closed entirely a drain inserted. The subsequent treatment is that for all forms hæmorrhage.

The operation for an *extra-peritoneal* rupture is slightly different its characters, since it is usually not undertaken for hæmorrhage, it in order to remove the products of gestation, to relieve the tient from pain, and to prevent a long and tedious convalescence ilst the hæmatocele is absorbing. The possibility that sepsis may ve already reached the sac must not be lost sight of. A median arotomy is performed in the Trendelenburg position, and the scera securely walled off by sterile gauze. Intestinal adhesions ay be present, and must be cautiously loosened so as to expose the c of the hæmatocele. This may give way during the manipula- ns to separate the intestine, or may need to be incised or tapped th a trocar. The mass is then isolated, its vessels tied, and com- ete removal follows; or it may be necessary to evacuate the ntents and drain or pack the cavity, especially when the blood has rrowed deeply into the pelvis between the layers of the broad ament.

When suppuration has occurred, the abscess must be treated on the me principles as guide us in the treatment of a pelvic peritonitis. may be possible to open and drain from the vagina, or the abscess ay have to be dealt with from above.

For the treatment of ectopic gestation which persists after the rth month, we must refer readers to larger textbooks.

Cysts of the Ovary and Broad Ligament.

Many different forms of cyst are developed in this region, and their origin from an embryological standpoint has been already alluded to (p. 218). The following classification may, however, be useful:

I. Cysts directly connected with the Ovary.

1. True ovarian cyst, single, multiple, or proliferating.
2. Paroöphoritic cyst with papillomatous developments.
3. Corpus luteum cysts.
4. Ovarian dermoid or teratoma.
5. Malignant ovarian cyst (usually carcinomatous).
6. Ovarian hydrocele.

FIG. 474.—PROLIFERATING CYSTO-ADENOMA OF THE OVARY. (KING'S COLLEGE HOSPITAL MUSEUM.)

The main cyst has been laid open to show the smaller cysts which project into its cavity.

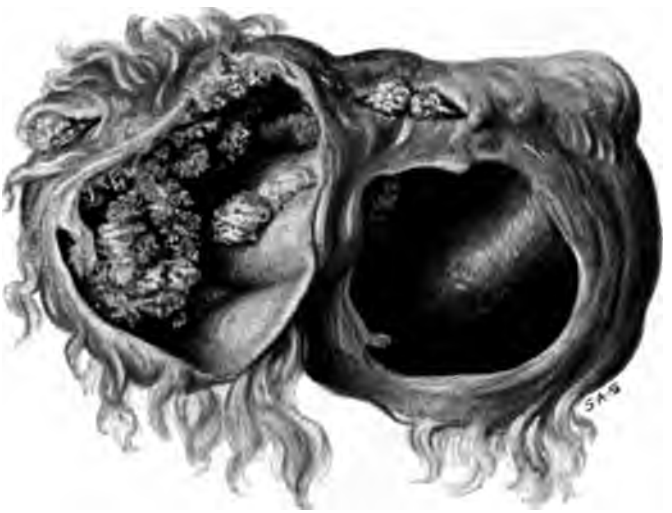
II. Cysts of the Broad Ligament.

1. Parovarian cysts.
2. Cysts of Kobelt's tubes.
3. Cyst of Gärtner's duct.
4. Fallopian tube cysts.
5. Lymphangiomatous developments.

True Ovarian Cysts, or, as they should perhaps be better termed, **cysto-adenomata of the ovary**, are usually multilocular swellings, volving one or both ovaries (more commonly the former), and ising from the tubular ingrowths of the ovarian epithelium or from ie Graafian follicles. As the swelling increases, the walls between ie loculi thin out and may be absorbed; but the usual appearance that shown in Fig. 474, where rounded cyst-like masses are seen

ɔjecting within the larger cyst, which has been laid open. The id is of a tenacious character, somewhat similar in type to mucin, d usually of a yellowish-white colour; if hæmorrhage has taken ıce into the cyst, the colour is of course modified.

The size of these cysto-adenomata varies enormously; they may be ıall as an orange, or large enough to compress the abdominal ntents and interfere seriously with respiration. The largest cyst this type we have dealt with contained 32 pints of fluid; the tient was 65 inches in circumference, and her legs were dripping with ɔpsy; she had been unable to lie down in bed for many months.



ɨ. 475.—Cyst of Ovary (Paroöphoritic) with Proliferating Papillomatous Intra-cystic Growths. (King's College Hospital Museum.)

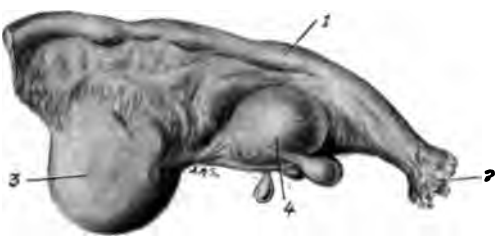
ıe walls of the growth vary in thickness and substance; sometimes ɛre is a considerable mass of newly-formed epithelial tissue, which time would undergo degeneration and form fresh cysts. The cyst covered externally with peritoneum, and possibly adhesions to ıentum or intestine may be present. The broad ligament and ıllopian tube become stretched by the traction and weight of the ıss and constitute a well-marked pedicle, which contains the trient vessels.

Paroöphoritic Cysts are very similar in character to the above, but ntain intracystic papillomatous developments (Fig. 475), which t unfrequently burrow through the cyst wall, and may invade the ritoneal cavity, and hence are semi-malignant. The primary ɔwth may be uni- or multi-locular, and in some cases large thin-ılled cysts develop containing large cauliflower-like excrescences, ıich are covered with columnar epithelium.

Corpus Luteum Cysts are usually multiple and not of great size, though occasionally they may be found as large as a fist. The fluid contained within is more or less thick, and dark in colour from blood extravasation, and the lining wall shows a definite overgrowth of lutein cells. The association of this type of overgowth with deciduoma malignum has been already mentioned.

For **Ovarian Dermoids or Teratomata**, see pp. 215 and 217. An ovarian dermoid is usually unilocular; it may manifest its presence at an early age, or not until middle life; it grows slowly, and is very liable to attacks of inflammation, probably resulting from partial torsion, and hence adhesions between it and other parts are not uncommon.

Ovarian Hydrocele is a condition, rarely observed, in which the ovary lies in a pouch in the broad ligament, the mouth of which becomes



IG. 476.—CYSTS OF KOBELT'S TUBES. (KING'S COLLEGE HOSPITAL MUSEUM.)

1, Fallopian tube; 2, fimbriated extremity of Fallopian tube; 3, ovary; 4, Kobelt's cysts.

closed through the development of adhesions so that a collection of fluid can occur outside the ovary. It is not likely to attain great dimensions.

Parovarian Cysts result from distension with fluid of the parovarium or organ of Rosenmüller, which in reality is the atrophied remnant of the Wolffian body, traces of which can often be seen in the broad ligament. As the cyst gradually increases in size, the layers of the broad ligament are separated, and the ovary and tube are pushed up and stretched over the growth, which usually burrows deeply into the pelvis by the side of the uterus. The cyst is generally unilocular, thin-walled, and contains a clear limpid fluid. Its method of development explains the fact that it has no pedicle.

Cysts of Kobelt's Tubes (Fig. 476) are frequently seen, and are of little significance. It is quite unusual for them to become large enough to cause symptoms.

Clinical History.—It is unnecessary to discuss here *in extenso* the symptoms which arise in the earlier stages when the cyst is small and intrapelvic. Suffice it that some disturbance of menstruation may occur, usually in the direction of menorrhagia, and that there may be a sense of intrapelvic pressure or pain, and possibly some inter-

ence with the bladder or rectum; the latter may be more marked the broad ligament cysts than in the true ovarian.

The patient is most likely to come under observation when the owth has emerged from the pelvis and become abdominal, and ssibly she may have noticed that the swelling appeared first on one le. As it increases in size, it becomes more mesial, and pushes up der the anterior abdominal wall, usually displacing the intestines ckwards and towards the sides of the abdomen. Hence on inspec- on the projection of the growth can often be seen, and there is no lging of the flanks such as occurs in ascites. Percussion elicits a ll note over the swelling, though the margins may be overlapped intestine and give a semi-resonant note; the flanks are resonant, hereas in ascites the anterior abdominal wall is resonant, and the nks and sides dull. Very little or no modification in the percussion te occurs on changing the position from the dorsal to the lateral cubitus, whereas in ascites this produces a marked alteration. On lpation the outline of the cyst may be easily tangible, and it may felt passing down into the pelvis. A tap sometimes produces a uid thrill, which is most marked in the unilocular parovarian cysts, d often absent in the multilocular variety, unless the front of the ass is constituted by a single large loculus. It may be possible to monstrate that the mass is mobile, especially on bimanual examina- on. The growth is usually found to drag the uterus upwards, and es not project down into the fornices; hence the vagina often pears to be very long, and the cervix is sometimes difficult to reach. he uterus may be displaced laterally.

Pressure symptoms of various types arise, such as impaired diges- on and constipation, leading to interference with nutrition, emacia- on and debility; œdema of the legs is caused by pressure on the na cava; the subcutaneous veins of the abdominal wall become pro- inent; and respiration may be considerably embarrassed. Should ven a small ovarian cyst become impacted in the pelvis, all the vidences of pressure may be at once exaggerated, and both rectum nd bladder are irritable.

Complications of various types ensue, and may quickly jeopardize ie patient's life. (i.) *Inflammation* arises from a variety of causes, g., traumatism or partial torsion; or the germs may gain access om some neighbouring viscus, *e.g.*, the appendix or Fallopian tube. he trouble may be of a slight and localized character, and then erely a few adhesions are developed; or it may be a deep paren- ymatous affection, followed by suppuration. The usual phenomena intra-abdominal inflammation are manifested: the patient com- lains of pain, and lies with the legs drawn up; the temperature raised; vomiting and possibly constipation are present; and on alpation the growth is tender, increased in size, and possibly less sily defined. If pus forms, it may escape into the peritoneal cavity one of the hollow viscera. Even if recovery follows, extensive dhesions may ensue and lead to serious consequences.

(ii.) *Torsion* of the cyst is predisposed to by the existence of a

well-marked elongated pedicle; it is impossible in the presence of extensive adhesions. It is probably determined by irregular contractions of the abdominal muscles, and the final disturbance may be caused by definite traumatism. From the fact that in acute cases the pedicle is found twisted on itself two or three times, it is obvious that slight attacks must have preceded the final outbreak of symptoms, and many of the slighter attacks of inflammation (usually supposed to be peritonitic in type) are probably of this nature. Finally, the torsion becomes so severe that the circulation in the cyst ceases, and strangulation ensues. An aseptic peritonitis follows, and unless relief is given in time death from generalized peritonitis and intestinal paralysis follows. The cyst becomes enlarged and engorged with blood; hæmorrhage may occur into its substance, and gangrene is likely to follow. The symptoms may come on suddenly after some effort, or there may be no obvious cause. Pain of a severe character is complained of, followed by shock; the tumour is obviously increased in size, tender and tense; vomiting and constipation suggest the existence of an acute intestinal obstruction, and if the case is not seen till late and there is no definite history of a cyst to be obtained, a diagnosis may be difficult or impossible apart from an exploratory operation.

(iii.) *Rupture* of the cyst may be spontaneous from gradual thinning of the walls, or due to traumatism. The results vary with the contents. A sudden rupture leads to severe pain and shock; this may be followed by inflammatory phenomena and peritonitis if the contents are of a sticky colloidal character, but, when limpid and serous, the fluid may be absorbed, and no harm follows. The cyst itself collapses, and is likely to develop adhesions, but the secreting substance persists, and the cavity may fill up again.

It is impossible to discuss fully here the **Diagnosis** of ovarian cystomata, and it must suffice to point out that the passage of a catheter eliminates the question of a distended bladder; that careful attention to the percussion phenomena, both in the dorsal and lateral decubitus, should suffice to determine the existence or not of ascites; and that vaginal examination and the passage of a uterine sound should exclude uterine conditions that might be mistaken. Before the introduction of a sound it is of course essential to exclude the possibility of pregnancy. The absence of changes in the cervix uteri and in the breasts, the non-existence of a uterine souffle on auscultation, or of a history of amenorrhœa, morning sickness, etc., should suffice to determine the absence of this latter condition.

Treatment for nearly all varieties of ovarian cyst is the operation of *Ovariotomy*, first performed in 1809 by Dr. Ephraim McDowell in Danville, Kentucky, and that with success. The essential idea of the operation is the removal of the cyst, and this may be accomplished either with or without tapping. The size of the growth will to some extent determine whether or not it should be tapped, but there are some conditions where it is unnecessary, *e.g.*, in small cysts, and others where it is undesirable, *e.g.*, dermoid cysts, and the pro-

rating papillomatous forms; in these latter there may be active
s in the fluid contents, and the escape of these into the peritoneal
ity (and it is not always possible to prevent such escape) may
ılt in infection of the peritoneum with these cells, and a new
elopment of some form of epithelial growth may ensue.

peration.—The patient is prepared in the usual way, the
ominal wall being purified and the vulva shaved; but unless
re is some objectionable discharge, there is no need to douche or
k the vagina. The Trendelenburg position may be advisably
pted, as it enables the surgeon to get at the pedicle of the cyst
e easily. An incision is made in the middle line above the pubis,
the anterior wall of the cyst is exposed. The finger or hand is
pt round in order to ascertain whether or not there are any
esions; if present, it may be possible to deal with them at this
e, but more usually it is easier to detach them later on. A
ncer Wells trocar is then thrust into the cyst, and as the fluid
ıpes, the relaxed wall is grasped by forceps and drawn up out of
incision so as to prevent the fluid getting into the peritoneal
ity. This end is not always attained, as the cyst wall is some-
es so soft and friable that it splits and bursts, and any attempt
rasp it with forceps leads to an increased rent in its substance.
ler these circumstances the patient can either be rolled over on
side, and the contents scooped out by the hand, or possibly better,
incision is rapidly increased in length to a sufficient extent to
w the whole cyst to be lifted up out of the abdomen. Large
ndary cysts may be opened by the trocar through the first main
, but in doing this care must be taken not to thrust the instru-
ıt through the posterior or lateral wall of the growth. The
icle is now securely tied off, and any form of ligature which
olves its transfixion will suffice. It is perhaps wise to divide the
icle at such a distance from the ligature that the main ovarian
sels can be recognised on the stump, and an ordinary silk or cat-
ligature can be separately applied to each of these; this plan
obviate any danger that might arise from the relaxation or
ping of the main ligature. The other ovary is then examined and
lt with according to circumstances. The peritoneal cavity is
nsed, and possibly when much of the cyst fluid has escaped it
be desirable to wash it out with salt solution, and the abdominal
sion is then closed.

road ligament cysts (parovarian) often have no pedicle, and then
st be enucleated after tapping. The layers of the broad ligament
divided in a suitable manner back and front; the supplying
sels are secured by ligature; and the cyst wall can usually be
d from its surroundings without difficulty. The opening in the
ad ligament is subsequently stitched up, and probably no drainage
be required.

n ovarian cyst with a twisted pedicle is treated in the usual way
untwisting. An inflamed or suppurating cystoma must be
t with according to circumstances; it may be possible to remove

en masse, but incision and drainage without removal may have to e resorted to.

An uncomplicated ovariotomy is one of the most successful major perations in surgery, and the death-rate is now phenomenally small. he presence of adhesions and other complications of course adds to ıe gravity, and increases the death-rate.

Solid Tumours of the Ovary are not very common, and consist carcinoma, sarcoma, or myo-fibroma. *Carcinomata* are solid or rstic; they grow rapidly, and early involve surrounding parts, roducing a generalized carcinomatous infection of the peritoneal ıvity with ascites. Unless cystic, they are often of no great size. *ırcomata* are usually more or less firm, and of the spindle-celled type, ıereby closely simulating the *myo-fibromata;* in the former, however, he growth is more rapid, and ascites is more likely to be present. n all these cases extirpation should be practised, if possible.

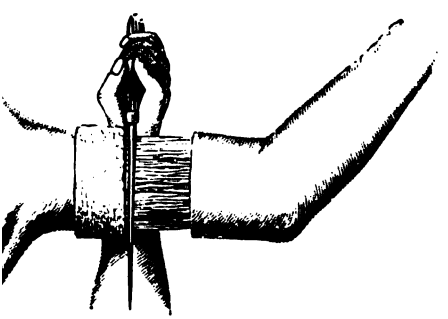
Salpingo-oöphorectomy, or removal of the ovary and its tube, is equired in many conditions, *e.g.*, small solid or cystic tumours, ıydro- or pyo-salpinx, and sometimes for dealing indirectly with noperable carcinoma mammæ. The operation may be simple in the ıxtreme, or one of the greatest difficulty if many adhesions are resent. The Trendelenburg position is adopted; the usual mesial ncision is made; the ovary is secured, and silk ligatures are carried hrough the broad ligament and tied above and below to secure the ovarian vessels. After removal of the tube and ovary, it is advisable o secure separately the chief vessels on the face of the stump. Adhesions are dealt with as may be required.

CHAPTER XLIII.

AMPUTATIONS.

the term **Amputation** is meant the removal of some portion of the body ich is injured or diseased to such a degree as to endanger the patient's life, o preclude any hopes of its restoration to a normal, or even useful, condition. this chapter we shall merely deal with the operation as applied to the remities, amputations of organs such as the breast and penis having been cribed elsewhere. Necessary limitations of space force us to treat the subject newhat briefly.

Methods of Amputation.—Since the introduction of anæsthesia, the methods ployed for the purpose of removing limbs have been almost revolutionized; re is now no necessity to hurry through the operation, and hence many new ceedings, and these sometimes of a most complicated nature, have been



. 477.—Circular Amputation for the Arm, showing Flap of Skin turned back, and Knife applied for Division of the Muscles.

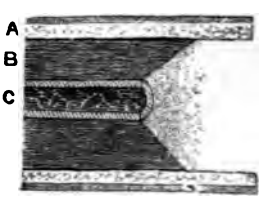


Fig. 478. — Section of Parts after Circular Amputation.

A, Skin and subcutaneous fat; B, muscles; C, bone.

ised. They are in the main merely modifications of three cardinal operations, circular, the racquet-shaped, and the flap.

The **Circular Amputation** (Fig. 477), although formerly much employed, is now little used; in it the skin and subcutaneous tissues are divided around the ole circumference of the limb by a circular sweep of the knife. These are n retracted or dissected back like a cuff, and the superficial muscles divided a similar manner. The soft parts are again further retracted, and the deeper scles divided, allowing the bone to be cleared and sawn through at a still her level. The end of the bone is thus placed at the apex of a conical hollow g. 478), and can be completely covered over; the vessels, moreover, are ided transversely. The stump is not very shapely, and after a time, owing to

the shrinking of the soft parts, the cicatrix is likely to become attached to the bone. The arm is almost the only situation in which a pure circular operation is ever undertaken at the present day; but a modified form is still occasionally utilized elsewhere. Thus, one or two vertical incisions may be associated with the circular cut, in order to facilitate the removal of the bone at a higher level, as in disarticulation of the hip-joint by Furneaux Jordan's method (p. 1306).

The **Racquet-shaped Method** (Fig. 484, A and C) is very similar to the last-described modification of the circular. In it an oval incision is made around the limb with one end pointed, and if necessary prolonged upwards to form, as it were, the handle of the racquet. This method is useful for removing fingers and toes, and is also employed at the hip and shoulder joints.

A somewhat similar operation is known as the **Elliptical** or **Oval Method.** In

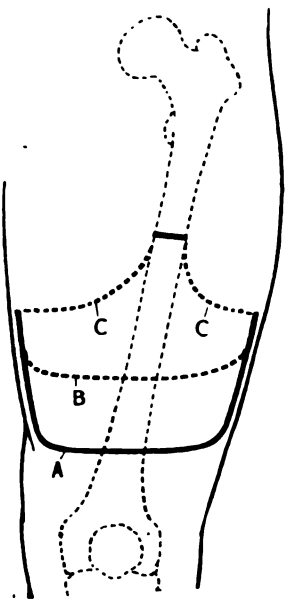


FIG. 479.—AMPUTATION OF THE THIGH BY LISTER'S FLAP AND CIRCULAR METHOD.

A indicates the anterior flap; B, the posterior, which is half the length of the anterior; C, the line of division of the muscles, which is performed by circular sweeps of the knife.

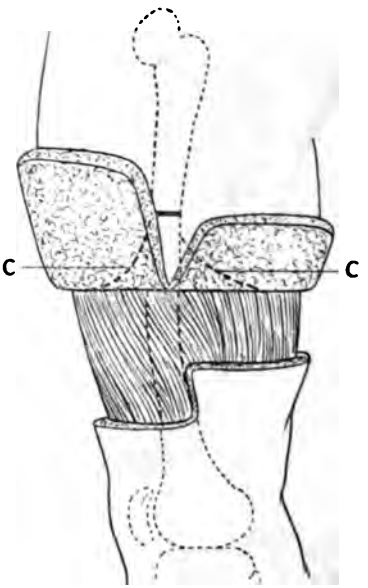


FIG. 480.—LATERAL VIEW OF THE SAME OPERATION WITH THE SKIN FLAPS DISSECTED BACK.

C again indicates the line of division of the muscles.

it an oval incision is made around the limb; the lower or distal portion is then dissected up so as to enable the amputation or disarticulation to be completed at a level a little below the proximal end. The free convex border of the flap is then turned over, and fitted into the concavity of the wound.

The **Flap Method** is that chiefly made use of at the present day in amputating through the shafts of the long bones. It was formerly performed by *transfixion* in order to save time; but the bulk of muscles included in the flaps, and the fact that the vessels and nerves are often sliced longitudinally, render this an undesirable proceeding. Hence it has been discarded, and the flaps are now usually marked out superficially, and then raised by *dissection.* As a rule, they

ıist merely of skin, subcutaneous tissue and deep fascia, a little muscle being ıaps included towards the base.

ıe best method of amputating in muscular parts, such as the thigh, is that ٧n as the **Modified Flap and Circular** (Figs. 479 and 480), which was originally ;ested by Lord Lister. In this two rectangular flaps with the corners rounded re raised on opposite sides of the limb, the length of the anterior being two-ls of the diameter of the limb at the point at which it is proposed to divide ɔone, and the posterior flap half the length of the anterior. These, consisting ely of skin and subcutaneous tissues, are dissected up ; the muscles are then led circularly, being retracted for another half-diameter. The advantages of the flap and circular methods are thus combined. In cutting the flaps it is most essential that they should not taper, but should remain the same breadth throughout, the corners being merely rounded off.

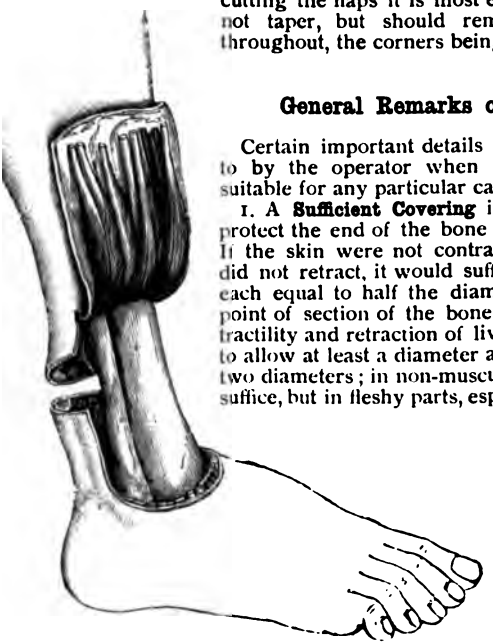


FIG. 481.—TEALE'S AMPUTATION. (TREVES' 'OPERATIVE SURGERY.')

General Remarks on Amputations.

Certain important details must always be attended to by the operator when selecting an amputation suitable for any particular case.

1. A **Sufficient Covering** is necessary, in order to protect the end of the bone from injurious pressure. If the skin were not contractile, and if the muscles did not retract, it would suffice to provide two flaps, each equal to half the diameter of the limb at the point of section of the bone ; but owing to the contractility and retraction of living tissues, it is essential to allow at least a diameter and a half, and sometimes two diameters ; in non-muscular parts the former may suffice, but in fleshy parts, especially when amputating low down in the thigh, where the range of muscular contraction is much greater, the latter. It is usually a matter of some significance whence the flaps are derived ; thus, a *single* flap, *e.g.*, a long anterior or posterior, is not to be recommended owing to the difficulty of maintaining its nutrition. *Equal* flaps are used in parts like the arm, where nd of the stump will not be exposed to pressure. Generally, however, the *ior flap* is cut *longer than the posterior*, as in the case of the modified flap and lar, or sometimes *vice versâ* ; in the former, owing to the additional retraction : muscles, a covering equal to two diameters of the limb is provided. *Teale's tation* (Fig. 481) consists in raising a long square anterior flap, equal in lth and length to half the circumference of the limb at the point of section of ɔne, and including everything down to the bone. The posterior flap is ır in nature to the anterior, but only a quarter of its length. The free end e anterior flap is doubled over, and accurately stitched to the posterior 482). The advantages claimed for this operation are that the vessels are cut and thus the nutrition of the flaps is secured, whilst a covering nearly equal o diameters of the limb is provided. The great objection to the method sts in the amount of the limb which has to be sacrificed on account of the ı of the anterior flap, and hence it is rarely employed. Occasionally the ing is derived from the sides of the limb (amputation by *lateral flaps*).

2. The **Cicatrix** should be situated away from the end of the bone, especially in the lower extremity, where the weight of the body has to rest upon the stump.

3. A **Dependent Opening** is desirable for purposes of drainage, and to ensure this the anterior flap is often made longer than the posterior. This, however, is not such an important matter since the introduction of antiseptic methods.

4. All these objects should be attained with as **little sacrifice of the limb as possible**, since the higher the operation, the greater the shock to the patient.

As to the operation itself, the greatest care must be taken to maintain **Asepsis**, since muscular and fascial planes have been freely opened, and possibly the medullary cavity of the bone exposed; the dangers of septic absorption under such circumstances are obvious. **Hæmorrhage** is prevented by previous exsanguination of the limb by elevating it for two or three minutes, and then applying an elastic tourniquet. In the leg a piece of rubber tubing may be employed, Samway's tourniquet being perhaps the best. In the arm, however, paralytic symptoms, usually involving the musculo-spiral nerve, have followed the use of such appliances, especially when made of solid rubber; a flat elastic bandage carried several times around the limb, and secured by a knot or with a safety-pin, is all that is needed. Should the tourniquet have to be applied close to the area of operation, it must, of course, be first sterilized; it is also advisable to protect the skin over which it is placed by a few layers of gauze. After the limb has been removed, the main vessels are at once ligatured, both artery and vein being separately tied. It is well to isolate and draw them down for a little distance, so as to make sure that they have not been buttonholed. Any other vessels which can be seen are tied before the tourniquet is removed. An assistant should for a time be ready to control the main trunk after releasing it from the tourniquet. In some cases it may be impracticable or undesirable to apply a tourniquet, and then the main vessels may be temporarily controlled by digital compression at some suitable spot whilst the amputation is completed. Any bleeding points are rapidly secured by pressure forceps and subsequently tied, and the main trunks isolated, and clamped or ligatured before division.

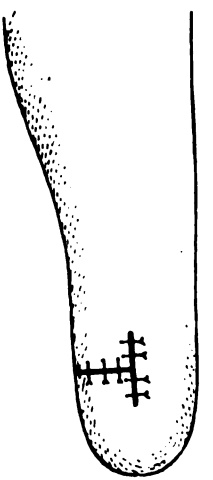


FIG. 482. — TEALE'S AMPUTATION COMPLETED, TO SHOW THE METHOD OF SUTURING THE FLAPS.

For special methods of controlling the hæmorrhage in amputation through the hip-joint, see p. 1306.

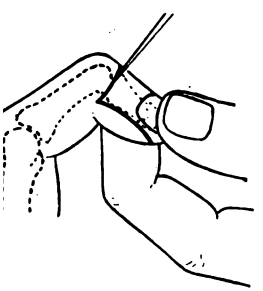
We have already drawn attention to the necessity of not tapering the flaps, but of cutting them square, the corners alone being rounded. In dissecting them up, the deep fascia should be included with the flap, and the blade of the knife always turned towards the part which is to be removed, so that the under surface of the flap, and with it the nutrient vessels, shall not be scored. Whilst dividing the muscles, the flaps must be carefully guarded by the hands of assistants. Before sawing the bone, it is recommended that the periosteum should be retracted for some distance, so as more efficiently to provide for its nutrition; this plan should certainly be adopted for the humerus and femur. Any irregular bony spicules left after sawing should be trimmed off with cutting pliers. Attention must next be directed to the main nerves and to any tendons which lie exposed in the wound, all such structures being cut short, the nerves as high as possible. It is always well to cover in the end of the bone by stitching the muscles together over it, and the little extra time expended in the introduction of these buried stitches will be well repaid in the increased shapeliness of the stump. The incision in the skin is usually closed by a continuous suture, and provision made for drainage from one of the angles of the incision. The dressing is applied in such a way as to draw the flaps down over the end of the bone, and a splint is generally necessary

rder to control the upper ends of the divided muscles and to keep them from ıful spasmodic contractions.

he chief **Complications** likely to arise in the subsequent course of the case shock, reactionary hæmorrhage, and those which result from sepsis; these ditions and their treatment have been described elsewhere.

ı a **Healthy Stump** the end of the bone is rounded, and the medullary cavity ed by a layer of compact tissue. The divided muscles and tendons are either ɔrporated in the cicatrix, or gain fresh adhesions to the bones. The vessels obliterated as far as the next patent branches, whilst the nerve-ends usually ɔme bulbous (Fig. 104, p. 373), but, if suitably shortened, do not adhere either he end of the bone or to the cicatrix, and hence give rise to no trouble. A ıcient covering of non-adherent skin and subcutaneous tissue should form a for the protection of the bones.

ffections of Stumps.—(*a*) *Necrosis* of the end of the bone is sometimes the ılt of carelessness on the part of assistants, who can readily denude it of its ıosteum by rough sponging, etc.; it rarely follows if the periosteum has been retracted before the bone is divided, and practically never apart from sepsis. mall annular sequestrum is usually all that separates, but should the inflam-ion spread up the medullary cavity (*septic osteomyelitis*), a more extensive tructıon of bone tissue follows (for symptoms and treatment of which see 81). (*b*) *Sloughing of the ends of the flaps* occurs in debilitated individuals, especially if thin skin flaps have been employed, or if their nutrition has been impaired by trauma, or if unhealthy tissue has been incorporated in their substance by amputating too close to the seat of disease or injury. The process is usually limited in extent, and rarely calls for treatment other than keeping the part dry and aseptic, the slough being then slowly absorbed; if sepsis is present, the consequences may be very serious, even necessitating re-amputation at a higher level. (*c*) A *conical stump* results either from the flaps being cut too short, or from the parts shrinking as a result of septic inflammation, or in young people from continued growth of the upper epiphyseal cartilage of the divided bone. In bad cases the bone may even project through the integument, and necrose; re-amputation is the only treatment. (*d*) A *painful stump* is usually due to the adhesion of a bulbous nerve-end to the trix or bone, so that it is dragged upon at each movement of the limb. The ı is of a severe neuralgic nature, and is treated by excising the bulb, or mputation. (*e*) A *spasmodic stump* sometimes occurs, being due either to ation of the enlarged nerve-ends, or to some central cause. In the former ınce, excision of the bulbs or re-amputation will cure the case; in the latter, trouble will persist in spite of treatment, affecting fresh groups of muscles r re-amputation.



. 483.—INCISIONS FOR MPUTATION OF TERMINAL HALANX OF FINGER.

Special Amputations.

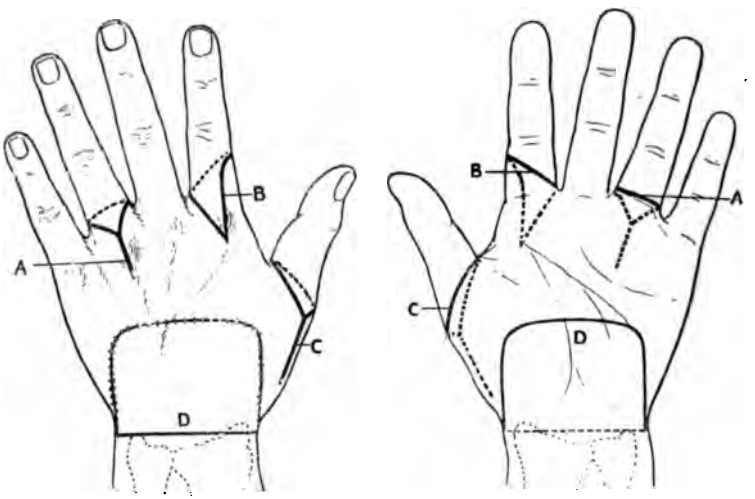
mputation of the Fingers is frequently required after machine accidents and ilar injuries, or in necrosis following a whitlow. In these cases it is often ossible to follow any regular routine, the flaps being obtained from any ion of sound tissue present. The following, however, are the chief plans pted:

mputation of the Terminal Phalanx is usually conducted by opening the t on the dorsal aspect, and cutting a palmar flap from the pulp of the finger . 483).

lo useful result follows amputation through the first inter-phalangeal articula-, since the portion left is practically fixed and useless, no tendons being

serted to govern it. An operation which is sometimes advantageous consists in amputating through the middle of the second phalanx, so as to leave the insertion of the flexor sublimis tendon, the flaps for such an operation being derived from any part of the finger, and the bone divided by cutting pliers.

Removal of a finger **at the Metacarpo-phalangeal Joint** is an operation frequently necessary. It is best conducted by means of a racquet-shaped incision (Fig. 484, A), which starts over the knuckle, extends between it and the next finger, curves round to the palmar aspect so as to be placed a little below the crease in the skin at the root of the finger (Fig. 485, A), and returns in the same way to the back of the knuckle. This incision can be made with one sweep of the knife, but there is no real advantage in such a procedure. The articulation is then opened from behind; the structures on either side are successively



FIGS. 484 AND 485.—DORSAL AND PALMAR VIEWS OF HAND WITH INCISIONS FOR VARIOUS AMPUTATIONS.

A, incision for amputation of finger by racquet method; B, Farabœuf's method of amputation, as applied for index-finger; C, racquet-shaped incision for disarticulation of thumb at carpo-metacarpal joint; D, amputation through the wrist by a long palmar flap. In all of these the continuous black lines indicate the portions of the incisions visible from the dorsal or palmar aspects respectively; the interrupted lines, the portions that are hidden.

divided, making them tense by rotation of the finger, and the flexor tendons finally cut across. Bleeding points (usually one on each side) are secured, and the wound closed.

The question of removing the head of the metacarpal bone is one which must be decided by the occupation of the patient; if he is a working man, or needs strength of hand, it should be left, as its removal always causes weakness. In ladies and those where smallness and elegance of the hand are required rather than strength, it can be taken away by slightly prolonging the incision upwards, clearing the bone on either side, and applying cutting pliers. The gap between the adjoining fingers can in this way be almost obliterated. It is especially advisable to do this in the case of the index-finger, since the head of the second metacarpal bone forms an unsightly projection, and is very exposed to injury. For this finger, Farabœuf's method (Figs. 484 B, and 485, B) is often used.

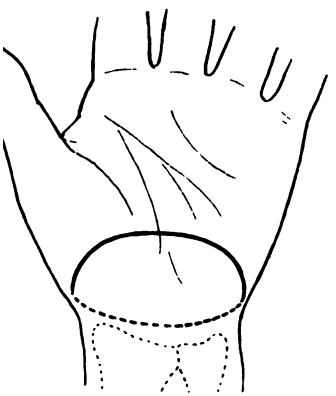
casionally the four fingers and their attached metacarpal bones have to be oved *en bloc*. Short equal flaps may then be cut from the front and back of hand, and the disarticulation effected. The stump that remains, although isting merely of the carpus and thumb, is very serviceable.

nputation of the Thumb should never be undertaken unless absolutely neces-, since its removal seriously impairs the functional utility of the hand ; as e a portion must be saved as practicable, so as to assist the patient in grasp-

The phalanges may be removed by any method which enables the bone to overed with the least possible sacrifice.

hen it is also necessary to take away the metacarpal bone, one of the two wing plans should be adopted :

The racquet method (Figs. 484, C, and 485, C). In this an incision commences ie intertendinous hollow known as the *tabatière*, and extends along the um of the thumb to the head of the metacarpal bone, the oval portion sweep- round it at the level of the web when the thumb is abducted, and on the ıar aspect corresponding to the oblique crease at its root. The remainder of the operation resembles that for removal of a finger. Care must be taken not to wound the trunk of the radial artery as it passes through the base of the interosseous space ; the blade of the knife is therefore kept closely applied to the bone.



486.—Amputation of the Wrist by Elliptical Method.

dark line indicates the palmar flap, e dotted line the dorsal incision.

2. By a *palmar flap*. In this the knife is first carried across the dorsal aspect of the thumb, from the centre of the web between it and the index-finger, to a point on the palmar surface of the wrist just above the thenar eminence. The knife is then rotated so that its cutting-edge looks outwards, and inserted deeply through the ball of the thumb, transfixing it, so as to emerge at the same spot in the centre of the web as that at which the incision commenced. A muscular flap with a well-rounded border is readily fashioned by cutting outwards. The remaining soft parts are then divided, and disarticulation completed by opening the joint. It is a prettier and more showy operation than the former, but otherwise has no advantages.

nputation through the Wrist-Joint is seldom performed except for injuries, hen the flaps must be derived as best they can from healthy tissues. Three methods are, however, described : (*a*) In the *elliptical* (Fig. 486), the in- n takes the form of an ellipse, the highest point being on the dorsum ½ inch v the level of the wrist-joint, and the lowest in the centre of the palm hes below the former. On the ulnar side, the incision passes between the ɔrm bone and the base of the fifth metacarpal, whilst on the radial side it ıes the carpo-metacarpal articulation. After dividing the cellular tissue, and cting up the palmar flap, the joint is opened from the posterior aspect, and lisarticulation completed. The convex end of the palmar flap is fitted into ɔncavity of the dorsum, and the cicatrix thus forms a curved line on the of the stump. (*b*) A *long palmar flap* (Fig. 485, D) is sometimes utilized, ıding from just below either styloid process down to about the middle of the carpal bones, the sides of this flap being parallel to each other. The dorsal ion crosses the carpus horizontally between the two extremities of the er wound (Fig. 484, D). The palmar flap is then dissected up so as to de only skin and subcutaneous tissue, with perhaps a little muscular tissue the thenar and hypothenar eminences. The wrist-joint is opened from the

dorsum, and the amputation completed by the division of the flexor tendons. (*c*) In a few cases, amputation by an *external flap* may be desirable (Dubreuil's method). The incision commences at the junction of the middle and outer thirds of the back of the wrist, reaches down to the head of the metacarpal bone of the thumb, terminating at a point in the palm immediately opposite its commencement. This flap is dissected up, and should contain a certain amount of muscular substance from the thenar eminence. The skin and subcutaneous tissues on the ulnar aspect are now divided by a circular sweep of the knife around the inner side of the limb. Disarticulation follows, and the external flap is carried inwards, and sutured so as to close the wound.

Amputation through the Forearm is usually conducted by means of a flap operation, the flaps being either equal in length or one a little longer than the other. The muscles are divided circularly, and the bones should be thoroughly cleared before division.

Disarticulation at the Elbow-joint is an operation very rarely seen, and is either undertaken by the elliptical method or with a long anterior flap.

Amputation through the Arm may be carried out by any of the methods described, *e.g.*, the flap, circular, or modified flap and circular, the choice in any particular instance being determined by the requirements of the case.

Disarticulation at the Shoulder-joint.—Three chief methods are practised for the performance of this operation, viz., Spence's, Larrey's, or that by means of an external or deltoid flap. In all, the third part of the subclavian artery may be controlled by digital compression, the surgeon endeavouring to leave the division of the main vessels until the last stage of the proceedings; but it is perhaps better to clamp all the smaller vessels as soon as they are cut, and to isolate and tie the main trunks before their division.

(*a*) *Spence's operation* (Fig. 487).—A preliminary incision similar to that for excision of the shoulder is first made, extending downwards and outwards through the fibres of the deltoid, from a point midway between the coracoid and acromion processes. This passes directly down to the bone, and, if necessary, the joint is at once opened and examined prior to any further steps being taken. The surgeon, standing on the outer side of the limb, then carries his knife from the lower part of the incision downwards and inwards across the axillary folds around the limb to the point from which it first started, thus making the incision racquet-shaped. The skin is first dissected up all round for an inch or so, and then the muscles on the inner side, the deltoid in part, the pectoralis major, the coraco-brachialis and biceps, are divided on the slant, thereby exposing the main vessels and nerves. The vessels may now be secured and divided, and the nerves isolated, pulled down and cut short, or they may be left intact for a time. The soft structures on the outer side of the vertical incision are next separated from the bone, and then the outer half of the capsule, together with the muscles inserted into the greater tuberosity of the humerus, and the long tendon of the biceps, are divided. The inner half of the capsule and the subscapularis are then cut through so as to free the head of the bone. By retracting the external flap and protruding the head from its socket, the posterior part of the capsule can be severed, and then the knife, travelling downwards between the humerus and the axillary vessels, is made to cut its way out, thus completing the disarticulation, the vessels and nerves, if not already dealt with, being divided as the last step in the proceeding. If the knife is kept close to the bone, the trunk of the posterior circumflex artery is not interfered with.

FIG. 487.—SPENCE'S AMPUTATION AT THE SHOULDER BY ANTERIOR RACQUET. (TREVES' 'OPERATIVE SURGERY.')

(*b*) *Larrey's operation* (Fig. 488) is very similar to the above, except that the vertical incision is made on the outer aspect of the joint, reaching downwards from the prominence of the acromion for a distance of about 6 inches, the oval

ion starting from its centre, and being directed obliquely downwards and ards. The tissues are reflected on either side of the humerus; the joint is ned by a transverse cut over the great tuberosity, which also divides the icles inserted into it. The knife is finally carried down on the inner side of humerus so as to sever the vessels last, if considered desirable.

) Amputation by the external or *deltoid* flap is but little practised at the ient time. The flap is either cut by transfixion, or dissected up. It is haped, its base extending from the coracoid process in front to the root of acromion behind. A skin incision is now made across the inner aspect of limb, joining the ends of the former incision, and extending about 2 inches ow the axilla. Disarticulation is then carried out in the same way as in the ious methods.

ccasionally it is necessary to remove the whole of the upper limb together n the scapula and outer third of the clavicle, for new growths, usually of a omatous nature, or for injury. This so-called **Interscapulo-thoracic Amputa-** is best performed according to Berger's method. An incision is made along clavicle, and the middle portion of this bone is then removed so as to enable surgeon to divide between ligatures the subclavian artery and vein on a level

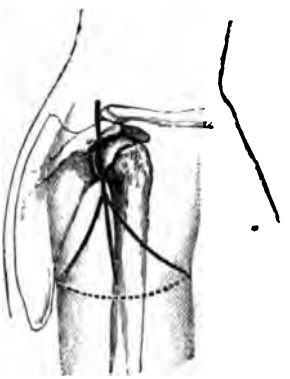


FIG. 488.—LARREY'S AMPUTATION THROUGH THE SHOULDER-JOINT BY EXTERNAL RACQUET. (TREVES' 'OPERATIVE SURGERY.')

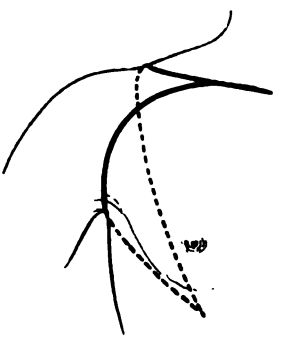


FIG. 489.—INCISIONS FOR THE INTERSCAPULO-THORACIC AMPUTATION.

h the lower border of the first rib. The anterior flap is then formed by an ision (Fig. 489) reaching from the centre of the former and extending down- rds and outwards over the shoulder, across the anterior fold of the axilla, and ar as the lower angle of the scapula. The pectorales major and minor are ided along this line, thereby exposing the brachial plexus, the constituent ves of which are severed on a level with the section of the vessels. The llary space can now be opened up along the outer surface of the serratus gnus. The limb is then rotated inwards and adducted across the trunk, and patient drawn well to the edge of the table so as to enable the posterior ision, which unites the outer ends of the two former, to be made. The flap s marked out is dissected up, and the different muscles retaining the scapula connection with the body are divided one after the other, including the ɔezius, omo-hyoid, levator anguli scapulæ, rhomboids, and serratus magnus. ɛse may be incised as near to the bone as is thought compatible with the l removal of the growth. Any remaining fibres are cut across, and the limb hus detached. In cases of new growth there may be a large number of sels, both arteries and veins requiring ligature; but in a healthy limb removed injury, none but the posterior scapular and supra-scapular will give any

rouble. Naturally, such an operation is accompanied by some amount of shock, ut the results hitherto obtained have been very gratifying.

Amputations of the Lower Extremity.

Amputation of the Toes at the metatarso-phalangeal articulations is precisely similar to the analogous operation on the fingers. It must be remembered that the joint lies as far behind the web as the apex of the toe is in front of it, and hence the incision must start farther back than might be expected.

For the removal of the great toe from the metatarsal bone, *Farabœuf's operation* is the best. The incision (Fig. 490) commences over the head of the latter bone, and well to the inner side of the extensor tendon ; it extends downwards nearly as far as the interphalangeal articulation, and then crosses the plantar surface of the toe so as to reach the centre of the web between it and the second toe ; thence

FIG. 490.—FARABŒUF'S AMPUTATION OF THE GREAT TOE. (TREVES' 'OPERATIVE SURGERY.')

FIG. 491.—INCISIONS FOR LISFRANC'S AMPUTATION. (TREVES' 'OPERATIVE SURGERY.')

the knife is carried straight back to the commencement of the incision. These cuts are deepened, the tendons divided, the joint opened, and the toe removed. It will then be found that an internal flap remains, which can be brought across the head of the metatarsal bone, and covers it in so that the L-shaped cicatrix is not exposed to pressure.

Amputation of the great toe at the tarso-metatarsal articulation is conducted either by a racquet-shaped incision, or by dissecting up a flap from the inner side. It is a bad operation, leaving a terribly mutilated foot, and should, if possible, never be undertaken.

Amputation of the foot at the **Tarso-metatarsal Articulation** is performed either by Lisfranc's or Hey's operation.

Lisfranc's amputation (Fig. 491) consists really of a disarticulation, no bone being sawn across. The patient lies on the back with the foot elevated, and extending beyond the end of the table. On the right foot a slightly convex dorsal incision extending down to the bones is made from the tip of the fifth

tatarsal bone on the outer side to the base of the first on the inner. The ntar flap is then marked out, reaching from the terminations of the former ision forwards as far as the roots of the toes, and being necessarily longer on inner than the outside side. On the left foot the incisions are made in the posite direction. This latter flap is dissected up, the toes being fully extended an assistant; only the skin and subcutaneous tissues are raised for the first h, but further back all the structures in the sole of the foot are included. The earance of the peroneus longus tendon will indicate that the dissection has n carried back far enough. Disarticulation is now performed from the dorsal ect, the line of the joints (Fig. 492) being kept in mind. The knife is entered ind the spur of the fifth metatarsal bone, and is at first directed forwards and ards towards the head of the first metatarsal bone. The line of the articulation is then followed as far as the base of the second metatarsal, which projects backwards between the internal and external cuneiform bones. The joint between the first metatarsal and the internal cuneiform is now opened transversely on the inner side, and the dorsal ligament between the second metatarsal and the middle cuneiform divided. The strong interosseous ligament passing between the internal cuneiform and the base of the second metatarsal is next severed by inserting the point of a knife downwards between the first and the second metatarsal bones, and cutting backwards towards the ankle, elevating the handle of the knife in order to do so. By grasping the toes in the left hand, and forcibly depressing them, the remaining ligaments on the dorsal aspect are divided, and the disarticulation can then be completed.

. 492. — SKELETON AND OUTLINE OF FOOT, SHOWNG LEVEL OF VARIOUS AMPUTATIONS.

The plantar flap is sometimes formed as the last stage of the operation, having merely been mapped out in the first instance. In such a case the dorsal incision is first made, the metatarsus disarticulated, and the plantar flap cut from within outwards.

Hey's operation is essentially similar to the above, with the exception that the projection of the internal cuneiform is sawn across (Fig. 492), leaving a more even surface of bone. It is certainly to be preferred to a simple disarticulation. *Skey* advised that the three outer joints should be opened as above, and that then the saw should be applied as to leave in its mortice the base of the second metatarsal, whilst the projection of the internal cuneiform is removed.

Amputation at the Mid-tarsal Joint (*Chopart's amputation*, Fig. 492) is conducted in a very similar manner to Lisfranc's. A plantar flap with convex end is marked out, reaching on the inner side of the foot from a point immediately behind the tubercle of the scaphoid forwards to within 1 inch of the root of the toes, and terminating on the outer side on a level with the calcaneo-cuboid articulation, *i.e.*, midway between an external malleolus and the spur of the fifth metatarsal. It should be 1 inch longer on the inner than on the outer side. This plantar flap is first dissected up, including everything down to the bones, and then a dorsal incision is made with a slightly convex border. The joints between the astragalus and scaphoid on the inner side, and between the os calcis and cuboid on the outer, are opened from above. Disarticulation is completed by a few touches of the knife, and after all hæmorrhage has been arrested, the plantar flap is drawn up, and united by sutures to the dorsal. Some surgeons prefer to fashion the plantar flap after opening the joints from the dorsum.

Chopart's amputation is not, on the whole, a very satisfactory proceeding,

since it consists in the removal of the anterior segment of the arch of the foot, the posterior half being left without support. The natural result of this is that the head of the astragalus travels downwards, and presses upon the anterior portion of the stump, causing a good deal of pain and discomfort, whilst the os calcis is drawn upwards by the traction of the tendo Achillis. Formerly it was considered that the resulting deformity was purely due to unbalanced muscular traction, and hence attempts to prevent it were made by dividing the tendo Achillis, or by stitching the extensor tendons to the under surface of the os calcis. Seeing, however, that the trouble is mainly mechanical, and hence unavoidable, it would perhaps be wiser to avoid the operation entirely, substituting for it a subastragaloid amputation, or modifying it by removing the astragalus after the foot has been taken away. Tripier's amputation has also been utilized to prevent such displacement; in it an oblique external racquet is made, reaching backwards to the anterior border of the tendo Achillis; disarticulation follows at the mid-tarsal joint, and then the os calcis is sawn across horizontally on a level with the sustentaculum tali, so as to leave a broad base of support, which is not so likely to become tilted forwards. It is but fair to say, however, that in not a few cases of Chopart's amputation an excellent stump remains without any of these inconveniences.

A still better modification,* where practicable, is to remove the foot on a slightly anterior plane, *i.e.*, to leave the scaphoid on the inner side, and to divide the cuboid on a level with its anterior border with a saw. The skin incisions can be made as for a Chopart. The stump left is longer, and therefore controlled more easily, whilst the attachment of the tibialis posticus is maintained, and it is easy to give the peroneus longus an insertion, so that the lateral movements of the foot are in great part preserved.

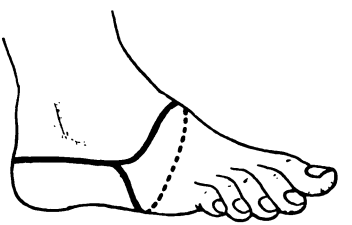


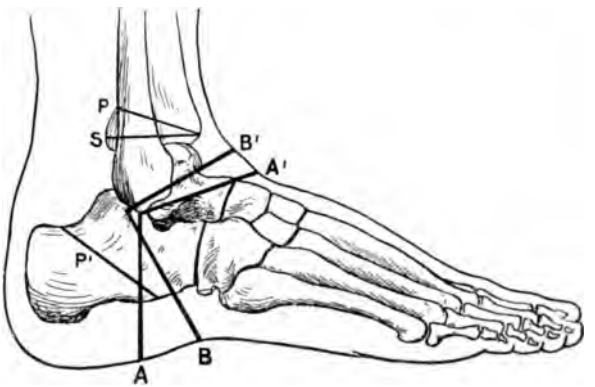
FIG. 493.—RACQUET INCISION FOR SUBASTRAGALOID AMPUTATION.

Subastragaloid Amputation of the foot is occasionally possible in cases of injury, where the astragalus remains uninjured. The best plan to adopt is that known as *Maurice Perrin's oval operation.* A racquet-shaped incision (Fig. 493) is made, commencing at the insertion of the tendo Achillis, and extending along the outer border of the foot to a point immediately behind and a little above the spur of the fifth metatarsal, from which it sweeps over the dorsum, along the instep, and after crossing the sole returns to the same spot. The dorsal part of the flap is then dissected up, the astragalo-scaphoid joint opened, the tendo Achillis divided, and by twisting the foot inwards the joints between the astragalus and os calcis can be entered, and the interosseous ligament severed. By still further inverting the foot until it assumes a position of extreme varus, the structures on the inner side of the os calcis can be detached, and by continuing the same torsion, the inner surface of the bone is finally cleared, the dorsal aspect of the foot looking downwards. When the foot has been removed, bleeding-points are secured, tendons and nerves cut short, and the wound, which now lies horizontally, is secured by sutures. A very firm basis of support is provided by this operation, and the stump is covered by the skin of the heel, which is accustomed to pressure.

Amputation of the Foot.—*Syme's amputation* consists of a disarticulation at the ankle-joint, together with removal of the two malleoli and the articular surface of the tibia. The patient lies on the back with the leg well elevated and projecting over the end of the table, the surgeon standing either below or a little to the right of the patient. Having exsanguinated the limb, the operation is, on the right foot, commenced by making an incision from the tip of the external malleolus down to the heel, and extending up to a point ½ inch below and behind the internal malleolus (Fig. 494, A). On the left side the incision is made in the

* *Gaz. des Hôpitaux*, January 21, 1902.

site direction. For this purpose a short-handled strong-bladed knife should mployed (an ankle-knife). The incision is directed slightly backwards, wise a bucket-shaped heel flap is formed, in which discharges may collect. knife is carried down to the bone at the first cut, and the surgeon then eeds to dissect up the heel flap thus marked out by inserting his thumb into vound, and partly peeling, partly cutting, the soft tissues from the back of s calcis. This is sometimes a tedious and tiring proceeding, since it is most rtant to keep close to the bone for fear of dividing the nutrient vessels of the (external and internal calcanean). The dorsal incision (A^1) is then made, ng the ends of the former wound, and carried slightly forwards so as ark out a short convex flap. This is dissected up, and the ankle-joint ed, the line of the articulation being placed ½ inch above the tip of the nal malleolus. By division of the lateral and posterior ligaments, of the Achillis, and of the few remaining fibrous connections along the top of the lcis, the foot is removed. The lower ends of the tibia and fibula are then ed and sawn off (S), the ends of the dorsal flap being meanwhile held out



G. 494.—LINES OF INCISION IN BONES AND SOFT PARTS IN SYME'S AND PIROGOFF'S AMPUTATIONS.

, Incisions for Syme's amputation ; B, B^1, incisions for Pirogoff's amputa- ion (these should really start from the same point as in Syme's operation, viz., the tip of the external malleolus, but to avoid confusion they have been placed a little behind it) ; S, section of tibia and fibula in Syme's amputation ; P, section of tibia and fibula in Pirogoff's amputation ; P^1, line of section of he os calcis in Pirogoff's amputation.

arm's way. The main vessels are tied, as also any other bleeding- s ; the tendons and chief nerves are drawn down and cut short, and the id closed by sutures, provision being made for drainage through one of ngles.

much quicker and prettier method of performing this operation consists in ing the joint, and disarticulating immediately after the incisions have been , whilst the os calcis is subsequently dissected out of the heel flap from e, keeping the knife close to the bone.

me's amputation gives excellent results with only slight shortening, and the nt is able to walk on skin which is already accustomed to pressure. It is ally useful where amputation is required for tarsal disease, inasmuch as it is rarely safe to undertake any of the partial or more conservative methods of ating.

rogoff's operation is one in which the posterior portion of the os calcis is sawn nd applied to the under surface of the previously sawn ends of the tibia and . The operation here described is not strictly that of Pirogoff, but rather

the modification suggested by Sedillot. The patient and surgeon being relatively placed as for Syme's operation, an incision is made extending from the same points, viz., between the tip of the external malleolus and a point ¾ inch below and behind the inner malleolus, but instead of passing directly downwards it is carried obliquely forwards (Fig. 494, B). Everything is divided at once down to the bone, and the dorsal incision is then made, being placed at right angles to the plantar (B^1). The ankle-joint is opened from above, and disarticulation completed; the structures to the side of and behind the joint are then divided, so that a saw can be applied to the exposed surface of the os calcis, and the bone cut in a direction more or less parallel to that of the plantar flap (P^1). The lower ends of the tibia and fibula are now cleared, and the malleolus and articular surface sawn off obliquely, the saw-cut being as nearly as possible parallel to that made through the os calcis (P). The object of this obliquity is to enable the sawn end of the posterior part of the os calcis to be brought into apposition with the similarly treated ends of the bones of the leg, and wired to them without any traction on the tendo Achillis. By this operation a somewhat longer stump is obtained than in Syme's, and the patient is able to walk on the posterior part of the os calcis instead of on the sawn ends of the tibia and fibula. The operation is more useful in cases of injury than for disease.

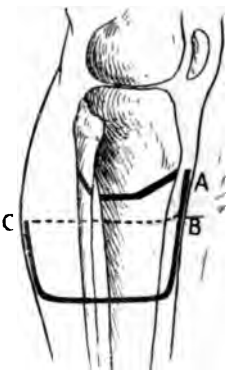


FIG. 495. FARABŒUF'S AMPUTATION AT THE SITE OF ELECTION, A HAND'S-BREADTH BELOW THE KNEE.

The continuous line, A, B, C, indicates the shape of the large external flap; the dotted line, B, C, the incision on the inner side of the limb. The direction in which the bones are sawn is also shown.

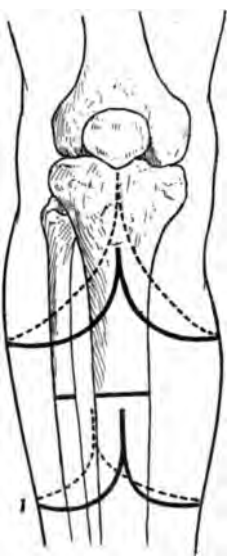
Amputations of the Leg may be undertaken either immediately above the malleoli (supramalleolar) or in the middle third, or a hand's-breadth below the knee (site of election). In the two former positions almost any operation may be practised according to the needs of the case, but perhaps the most satisfactory is that by means of equal lateral flaps, each of which is equal in length to one diameter of the limb, and consists below of skin, fat, and deep fascia, but for the upper half the muscles are also included (Fig. 496, 1). In dividing the bones, care must be taken not to leave a sharp projecting edge on the front of the tibia. This is best prevented by partially sawing through the bone in an oblique direction from above downwards, and when this has reached a little beyond its centre, the saw is withdrawn, and a horizontal section made, cutting across the oblique incision in such a way as to remove a wedge of bone from the front of the tibia, which thus becomes suitably bevelled. The fibula should always be divided before completing the section of the tibia.

In the lower third of the leg, Teale's amputation (Fig. 481) is sometimes recommended, and gives good results.

Amputation of the Leg at the Site of Election may be performed either by the modified flap and circular operation, or by a large external flap (*Farabœuf's operation*). In the latter, the external flap (Fig. 495, A, C), which is U-shaped, is first marked out with the knife, extending 1½ inches higher in front than behind, and its length being equal to the diameter of the limb at the point at which the bones are to be divided. The incision on the inner side is then made, extending directly across the limb from a point 1½ inches below the upper end of the anterior horn of the former incision to its posterior extremity (B, C). The

rnal flap is dissected up, commencing anteriorly; the fingers and knife being rted between the tibialis anticus and the tibia, all the soft parts down to the e and interosseous membrane are divided obliquely. The anterior tibial ·y is cut long, and care must be taken not to free the flap from the interosseous ıbrane too high, for fear of injuring the trunk of this vessel as it passes veen the bones, an accident which would seriously imperil the vitality of large and fleshy mass. The tissues on the inner side of the limb are now led, either by transfixion or circular division. The interosseous membrane bones are bared, and the saw applied according to the method already ribed.

sarticulation at the Knee-joint is a very useful and valuable proceeding. methods chiefly employed are as follows: (i.) *Stephen Smith's operation*, or utation by equal lateral flaps. The incisions extend from a point immediately below the tuberosity of the tibia backwards in a semilunar fashion, to terminate in the middle line behind on a level with the joint (Fig. 496, 2). The incision on the inner side should reach a little lower than that on the outer, in order to ensure sufficient covering for the inner condyle, which is always larger than the outer. The flaps are dissected up all round, including the subcutaneous and deep fascia, being turned back in front like a collar, so as to enable the surgeon to reach and divide the insertion of the ligamentum patellæ. The knife is now carried along the upper margin of the tibia, separating the attachments of the semilunar cartilages to the bones by dividing the coronary ligaments. The surrounding muscles and tendons are cut through at the same level, together with the crucial ligaments, and the leg is finally separated by boldly sweeping the knife through the soft parts at the back of the joint, the flaps being well retracted. The popliteal vessels are secured, and the flaps drawn together in the median line. When union has occurred, the cicatrix is drawn up behind into the intercondyloid notch so that an excellent hooded covering is provided for the lower end of the femur. The chief objection to the operation is that the upper part of the synovial membrane of the joint remains intact, and may become distended by a serous effusion through the irritation produced by wearing an artificial limb. (ii.) Amputation can be undertaken *long anterior flap*, the patella being left *in situ* or removed, according to mstances. A short posterior flap is also formed and dissected up, so as to le the muscles and vessels to be divided transversely.



496.—1, AMPUTATION OF THE G BY LATERAL FLAPS; 2, EPHEN SMITH'S AMPUTATION ROUGH THE KNEE-JOINT.

pracondyloid Amputation of the Thigh is an operation often requisite in to deal with disease or injury involving the knee-joint. (*a*) *Carden's tation*, slightly modified, is one excellently adapted to this purpose. An ior flap (Fig. 497, A) is fashioned from the most prominent point of one yle to that of the other, the incision crossing the mid-line in front halfway een the patella and the tibial tubercle. This flap is dissected up in front of atella as far as its upper border. A short posterior flap is then dissected up en made his posterior incision horizontal). A transverse cut above the a lays the knee-joint open, and after flexing the limb the lateral and crucial ents are divided. The hamstring muscles, etc., are severed by cutting from ut inwards, and a few touches of the knife will then serve to disarticulate.

The muscles are retracted, and the femur divided a little above the condyles. (*b*) *Lister's modification* (Fig. 497, B) consists in making a transverse incision across the front of the limb on a level with the upper border of the tubercle of the tibia. The horns of this incision are joined posteriorly by carrying the knife downwards at an angle of forty-five degrees to the axis of the leg. This flap is dissected up, and the whole of the integuments and subcutaneous tissues are freed and retracted like a cuff, so as to enable the muscles to be divided circularly just above the patella. The saw is then applied, and the bone removed. By this means the covering of the end of the bone is taken more from the back than from the front of the limb. (*c*) *Gritti's operation* (Fig. 498) is thus performed: A large anterior flap similar to that used in Carden's operation is dissected up, including the patella, and a shorter posterior flap is then fashioned. The soft parts are divided by a circular cut of the knife, and the femur sawn across about the level of the adductor tubercle. The cartilaginous surface of the patella is then removed with the saw, and the remaining portion of the bone secured by a silver wire to the divided end of the femur. Considerable difficulty may be experienced in

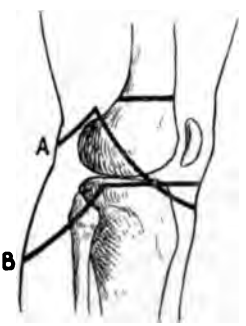


FIG. 497. — INCISIONS FOR SUPRA-CONDYLOID AMPUTATION OF THE THIGH.

A, Carden's operation; B, Lister's modification of the same.

FIG. 498.—STOKES-GRITTI AMPUTATION, SHOWING INCISION IN THE SOFT PARTS AND THE LINES OF SECTION IN THE FEMUR AND PATELLA.

keeping the patella in accurate apposition, and to obviate this Stokes recommended division of the femur at a slightly higher level—*i.e.*, above rather than through the condyles. (*d*) Amputation by a *long posterior flap* is sometimes required in cases where the tissues in front of the limb have become disorganized from disease of the joint, or when cicatrices produced by a previous excision are present. The posterior flap is first marked out and dissected up, including merely the skin and subcutaneous tissues. A transverse incision is made across the limb above the cicatrices or sinuses, the bone sawn just above the site of the preceding excision, and the posterior muscles and vessels divided circularly. A very good stump usually results.

Amputation of the Thigh may be conducted by any of the general methods already described, but Lister's operation, modified flap and circular (Figs. 479 and 480) is perhaps the best.

Amputation through the Hip-joint.—Disarticulation at the hip-joint is always an operation of the greatest gravity, and every precaution should be taken to

nize the immediate risks by preventing hæmorrhage and lessening shock. irt of the body should be unnecessarily exposed, whilst the head is kept low, lthough the operation must not be hurried over, no time is wasted.

haps the best way of preventing hæmorrhage is to secure the main vessels : dividing them, and then to take up each bleeding point as it appears; the :an thus be removed with the loss of merely a few ounces of blood. Other which have been suggested are: (*a*) Lister's aortic tourniquet, which, ver, is not to be recommended, partly because it is difficult to apply to stout ıscular individuals, and in any case it is very liable to slip. (*b*) Davy's rectal for compression of the common iliac artery consists of a rod of ebony, nite, or metal, which is inserted into the rectum, and directed so as to ress the artery against the brim of the pelvis. It is dangerous in application, ıot always efficient. (*c*) An elastic tourniquet may be applied either around pper part of the thigh to control the lower end of the external iliac, or d the body in such a way as to compress the abdominal aorta. For the purpose a pin-cushion or pad is placed on the abdomen over the aorta, and d the back a board projecting a few inches on each side of the trunk, and two notches cut at either end. The elastic rod is passed over the cushion, round the notches at the end of the board in a figure-of-8 fashion, sufficient ın being employed to force the cushion down on the aorta, and thus control irculation through it. This method, which was also suggested by Lord ', is certainly efficient, though somewhat cumbersome. (*d*) More recently h, of New York, has introduced a method of preventing hæmorrhage by ing a rubber tourniquet close to the pelvic brim, which is prevented from ng by inserting long needles immediately below it. The limb is first guinated by elevation, or possibly by the use of an Esmarch's bandage. long steel needles, 10 inches in length and $\frac{1}{16}$ inch in thickness, are then ed, one on the outer side of the thigh and one on the inner. The former is luced ½ inch below the anterior superior spine of the ilium, and slightly to ıner side of this prominence, and is made to traverse superficially for about ıes the muscles and fascia on the outer side of the hip, emerging on a level the point of entrance. The point of the second needle is thrust through the ınd tendon of origin of the adductor longus muscle ½ inch below the crutch, ɔi t emerging 1 inch below the tuber ischii. The points should be shielded :e with cork to prevent injury to the hands of the operator. No vessels are ıgered by these skewers. A mat or compress of sterile gauze 2 inches thick ; inches square is laid over the femoral artery and vein as they cross the of the pelvis; over this a piece of strong white rubber tubing, ½ inch in :ter when unstretched, and long enough when in position to go five or six round the thigh, is now wound very tightly around and above the fixation es and tied.'* By this means the limb can be removed with practically no f blood.

merly but one operation was utilized for the removal of the limb at the hip- viz., by transfixion, the flaps being cut antero-posteriorly. The great ıtage of this method was the rapidity with which it was executed; it has, ver, been replaced by other plans, one of which should always be adopted. ıputation by an *external racquet incision* (Fig. 499; right leg) has been recom- ed by many surgeons, especially Furneaux Jordan, Esmarch, and Lister, each ıom has advocated some slight modification. The surgeon should always to the outer side of the limb, whilst the pelvis of the patient rests at the ne edge of the table. The essential features of this operation consist in a ar division of the structures down to the bone below the lesser trochanter, t the head of the bone is disarticulated and removed through the external al portion of the incision extending downwards from above the great ınter; it matters little whether the vertical incision is made before or after ssues in the thigh have been divided. Perhaps the simplest plan of carrying is operation is as follows: A circular incision is made through the skin and taneous tissues 5 or 6 inches below the great trochanter. These are dissected : a few inches, and the muscles divided circularly down to the bone, which

* Wyeth, *Annals of Surgery*, February, 1897.

is at once sawn through. The external incision, 6 or 8 inches long, is then made, the tissues being freed from the anterior and posterior surfaces of the femur, and the rotator muscles divided along the borders of the great trochanter. The lower end of the fragment of the femur is then grasped by lion forceps, and after forcibly flexing and rotating the bone inwards, the capsule of the joint is laid open on its posterior aspect. By everting the bone, the anterior part of the capsule can be reached and incised, and the attachment of the ilio-psoas muscle severed. The ligamentum teres is then divided by inserting the point of the knife into the acetabulum, and the head of the bone is thus set free. One great advantage of this operation is that the incisions are placed as far as possible from the risk of septic contamination from the genital organs and perineum.

To our minds, the best method of amputating at the hip-joint is by means of an

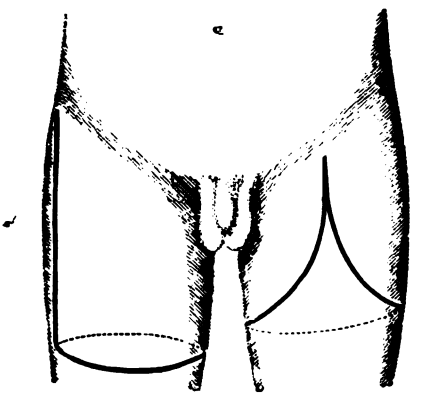


FIG. 499.—AMPUTATION THROUGH THE HIP-JOINT.

On the right leg Furneaux Jordan's method is indicated; on the left leg the flaps required for the anterior racquet operation are shown.

anterior racquet incision (Fig. 499; left leg). This commences over the centre of Poupart's ligament, and is carried down along the course of the main vessels for about 3 inches. The common femoral sheath is exposed, and both artery and vein are secured by double ligature and divided. The incision is then completed; it sweeps over the inner side of the thigh 4 or 5 inches below the perineum to the back, and is brought up again to the front 3 or 4 inches below the great trochanter. The muscular structures in the outer flap are then cut through, and the external circumflex artery and other bleeding vessels secured by pressure forceps *en route*. By rotating the limb inwards, the insertion of the gluteus maximus can be divided, as also the muscles attached to the great trochanter. The muscles in the inner flap are then similarly dealt with after rotating the limb outwards, the internal circumflex artery, etc., being secured. The capsular ligament is next divided transversely, and the head of the bone disarticulated. Finally, the limb is rotated forcibly outwards, and all the soft parts at the back of the limb, including the sciatic vessels and nerves, are divided from within outwards with one sweep of the knife. The wound when sutured lies antero-posteriorly.

CHAPTER XLIV.

ANÆSTHESIA.

practice of surgery has always been of such a nature as to render some
s of abolishing the pain caused thereby a desideratum ; but although in the
ays various plans were adopted to attain this object, yet it was not until the
f the eighteenth century that any real advance was made in this direction.
99 Sir Humphry Davy suggested the possibility of using nitrous oxide gas
neans of rendering patients anæsthetic during surgical work ; but as then
oyed, it was so uncertain in its action that no great benefit was derived from
nowledge thus acquired, and many years elapsed before it came into ex-
/e use. The demonstration of the properties of ether in 1846 by Morton, in
delphia, and of chloroform in January, 1847, by Sir James (then Professor)
son, heralded in a new era of surgery. Operations, which before were
y in number, became greatly multiplied, and at the present day, with our
ıced knowledge and experience, and our constant dependence on this agent,
lifficult to understand how surgical practice could have been conducted
ıut it. Anæsthetics have enabled the surgeon confidently to attack almost
region of the body, and instead of operations being hurried over, in order
ıimize the patient's sufferings, they are now undertaken with much more
:ration, accuracy being the great requisite at the present day, and not, as
:rly, rapidity.

æsthetics may be divided into two groups—the local and the general.

al Anæsthesia is utilized for the purpose of rendering parts insensitive
ıin, where slight operations of short duration are to be undertaken, or,
ionally, in more serious cases, where the patient cannot stand a general
hetic.

Jocaine is an alkaloid obtained from the dried leaves of the *Erythroxylon*
S. America). The salt most commonly used is the hydrochlorate, which
in the form of colourless needles, or a crystalline powder readily soluble
ıter. Its properties as a local anæsthetic were discovered by Köller of
ıa, and it was at the Ophthalmic Congress at Heidelberg in September,
that its value in ophthalmic and surgical work was first publicly demon-
l.

cous membranes are readily anæsthetized by applying a 5 or 10 per cent.
on to them for about five or ten minutes, the insensibility lasting for about
me time. In dealing with the skin or deeper tissues, hypodermic injections
drug are relied on, the anæsthesia following the course of the peripheral
s. The action of cocaine is supposed to depend partly on an anæmic con-
of the affected tissues induced by arterial contraction, partly on paralysis
terminations of the sensory nerves. Inflamed tissues are but little affected
When applied hypodermically the needle should be inserted in the line
ision, and the injection equally diffused along it. In making use of this
ıt, it must always be remembered that cocaine has a distinctly depressing
ıce upon the heart, and hence more than ½ grain should never be
yed. Should toxic effects be manifested (as by pallor of the face, a cold

clammy sweat, giddiness, weak and rapid pulse), the patient's head should be lowered, and stimulants administered. Some recommend that a little nitroglycerine (1 drop of a 1 per cent. solution) should always be injected at the same time as the cocaine, so as to prevent contraction of the peripheral arterioles. In some parts of the body it may be possible to control the circulation so as to hinder the general absorption of the drug. Thus, for circumcision the base of the penis may be constricted by an elastic band, whilst a similar arrangement may be applied to the fingers and toes for small operations, such as avulsion of a toe-nail.

2. A substitute for cocaine has recently been proposed in the synthetic compound known as **Eucaine Hydrochloride**. Its toxic properties are much less marked than those of cocaine, and doses of even 5 or 10 grains may be employed either hypodermically or by painting over a mucous membrane. Its action is somewhat slower than that of cocaine, and it causes a little congestion of the part, whilst cocaine leads to anæmia; it also gives rise to a little tingling pain on injection, and may leave a certain amount of œdematous thickening for a time. The reports hitherto given have been very satisfactory, although, on account of the irritation produced, it does not seem to be quite so suitable for ophthalmic work.

Schleich's Method of inducing local anæsthesia consists in infiltrating the tissues of the part with a dilute solution of cocaine. This has been modified of late by the employment of eucaine and adrenalin, and Barker* recommends the following formula:

Distilled water	100·0 c.c.	= 3½ ounces
β-eucaine	0·2 gramme	= 3 grains
Sodium chloride	0·8 gramme	= 12 „
One pro mille adrenalin chloride solution		10 minims

There are no toxic effects associated with this solution, and a considerable quantity is employed in order to infiltrate the tissues. If allowed to act for thirty or forty minutes, the parts are often found to be not only anæsthetic, but also practically bloodless. Operations of gravity can be performed without pain, including such conditions as strangulated hernia, intestinal obstruction, tracheotomy, thyroidectomy, etc., when a general anæsthetic may be undesirable.

3. Local anæsthesia is also produced by **freezing** the part, either by the application of ice and salt, or by the ether spray, or with ethyl chloride. The latter reagent is now put up conveniently in small glass or thin metal flasks with a fine capillary outlet; on holding the flask in the hand a spray is produced, which is allowed to play upon the part to be operated on. The rapid evaporation from the surface leads to the freezing of the skin, which becomes of a dead white colour. The anæsthesia produced is of a very fugitive nature, and a certain amount of pain may be associated with the thawing process, but less than that caused by the ether spray.

General Anæsthesia.—1. **Nitrous Oxide Gas** (N_2O) is most commonly used in dental work, or for short operations, such as bending a stiff joint and breaking down adhesions, the avulsion of a toe-nail, or the opening of an abscess. It is practically safe and not unpleasant, either in its use or in its subsequent effects. It is also employed in conjunction with ether, the patient being first anæsthetized with gas, and the condition maintained by ether. Gas has also been recommended for the removal of adenoids; but the general opinion now obtaining is that, to perform this operation satisfactorily, a more lasting anæsthetic is required. The gas is stored in a condensed and liquefied form in special steel cylinders, closed by a screw which can be readily loosened, so as to allow the gas to escape through a tube into an indiarubber bag. This is attached to a closely-fitting face-piece, with a suitable arrangement of valves and stop-cocks, by means of which the gas is allowed to reach the patient. A valvular exit for the expired air is also present (Fig. 500). In its usual method of administration the bag is first filled with gas, and then air is completely excluded by carefully adjusting the padded face-piece to the irregularities of the face. Some anæsthetists, however, by means

* *Brit. Med. Journ.*, December 24, 1904, p. 1683.

ɔecial apparatus devised by Dr. Hewitt, allow the administration of a proportion of pure oxygen at the same time, in order to prevent the of the face and the twitching of the limbs often present when anæsthesia ɔed in the ordinary way. These symptoms of incipient asphyxia may also ded by allowing the last few inspirations of the gas to be mixed with air.

500.—Apparatus for the Administration of Nitrous Oxide and Ether in Combination.

l cylinders containing compressed nitrous oxide ; B, indiarubber bag ; three-way stop-cock with valves ; D, Clover's ether chamber ; E, face-ce. If nitrous oxide alone is administered, D is omitted. When ether ne is used, A and C are omitted, and a smaller bag substituted for B.

ay be done by raising the face-piece, by opening the air-valve, or, as ɛd by Dr. Flux, by using an open inhaler into which the gas is poured. ˈse, in removing teeth the mouth is firmly gagged open prior to the com-ɪent of the administration.

loroform is perhaps the anæsthetic most generally employed, on account

of the ease with which it can be administered, although there can be but little doubt that its use is attended with somewhat more risk than that of ether. Much controversy has arisen as to whether the heart is ever directly affected by the drug, or whether the dangerous symptoms met with are not due to primary failure of the respiration. The experimental evidence on the subject is of a very conflicting nature; and it is impossible as yet to consider the question solved. The Scotch school of surgeons, headed by Syme and Lister, has always maintained that the breathing alone need be watched during the administration of chloroform, failure of the respiration being the first danger signal; the second so-called Hyderabad Commission has sought to confirm this view. Many practical surgeons and anæsthetists oppose this statement, holding that, although the respirations may fail first in a large percentage, and probably a majority, of fatal cases, yet there are a certain number in which heart failure is also seen as a result of the direct toxic effect of the chloroform upon its muscular substance. Certainly, in not a few instances of death during the administration of chloroform the heart stops first, but a great distinction must be drawn between the *deaths* which result *from chloroform*, and the *deaths* that occur *during* the administration of *chloroform*. An overdose of chloroform, without doubt, leads to failure of the respirations; but in the majority of such cases, if suitable precautions are adopted sufficiently early, a fatal result may be averted. Cases in which the heart stops first are probably due to syncope, and are not entirely dependent on the nature of the anæsthetic administered.

Chloroform may be given in several different ways, but in all the chief points to be attended to are regularity of dose, and full admixture with air, so that not more than 4 per cent. of the vapour is inspired. The plan so often employed of pouring an unknown quantity of chloroform on a piece of lint, folded in two or three layers and held close to the patient's nose and mouth, is most unscientific and to be strongly condemned. The **Open Method** is that recommended by Lord Lister. A mask reaching from the root of the nose to the chin is made from the side of a towel, and fixed with a safety-pin. This is first held some inches above the patient's nose, and moistened from the outside with chloroform from a drop-bottle. As the respiratory passages become tolerant of the drug, the mask is gradually lowered to touch the face, and is kept continually moistened. At the end of two or three minutes the respirations increase in frequency, and a stage of excitement may be reached, during which the patient may sing, shout, or struggle violently. The anæsthetic is still cautiously pushed, care being taken that during the deep respirations which follow the struggling stage an overdose is not administered. Complete anæsthesia is indicated by relaxation of the muscles, loss of the corneal reflex, and contraction of the pupil, and it is usually attained in about five minutes. As long as the operation lasts, the anæsthetist must endeavour to maintain this condition, but the amount needed during the later stages is much less than at its commencement.

Junker's inhaler is often used for giving chloroform, especially in operations about the nose and face. It is economical, and on the whole satisfactory. In this apparatus air is pumped through a layer of chloroform to an inhaler placed over the patient's mouth, or to a tube passed into his nose. The air laden with chloroform is inspired, and produces the usual constitutional effects; the amount administered is, to a certain extent, regulated by the rapidity with which the india-rubber bulb of the apparatus is squeezed; after a time, however, the lowered temperature induced by the evaporation leads to a diminution in the amount of chloroform vapour given off. Accidents have happened with this apparatus from filling the bottle too full, or from having the indiarubber tubes fixed to the wrong nozzles; in either instance liquid chloroform may be pumped out of the exit-tube.

3. **Ether** is generally considered to be a safer anæsthetic than chloroform, in that it is a cardiac stimulant. It is usually administered by Clover's apparatus or by an Ormsby's mask.

Clover's apparatus (Fig. 500, D and E) consists of a face-piece similar to that utilized for giving nitrous oxide, a metal receptacle for the ether, and a bag. In this apparatus the air used in respiration passes over the surface of the ether contained in the receptacle, the proportion of ether inspired being regulated, so that

t a considerable admixture of air is permitted, whilst later on ether vapour
: proportion of a third, a half, or even two-thirds, is inhaled. The chief
tage of this apparatus is the ease with which the amount of ether adminis-
is regulated; but a distinct disadvantage exists in the fact that the patient
ıes his own expired air again and again, and so, unless care is taken, he is
to become cyanosed. This can, however, be prevented by removing the
occasionally, and giving the patient a few breaths of unmixed air. Another
ion lies in the amount of mucus which often collects about the pharynx,
the moisture in the expired air condenses in the bag, which becomes very
ionable unless carefully washed out after each administration.

Ormsby's mask the ether is poured over a sponge which is contained in a
rame prolonged from the face-piece, and covered over by a bag into which
atient breathes. It is an unpleasant means of inducing anæsthesia, but
ıe-employed for maintaining it after the use of gas. The same objections
good as in Clover's apparatus, and the same precautions as to letting in
pheric air from time to time must be observed.

he administration of ether it is now usual to adopt what is known as the
ınd ether method,' by which is meant that the patient is first anæsthetised
nitrous oxide, and the anæsthesia is continued and maintained by means
er. If the Clover's inhaler is to be employed, the arrangement shown in
ioo is employed, a Clover's ether-chamber being interposed between the
iece and the three-way tube of a nitrous oxide apparatus. The patient is
llowed some six or eight full inspirations of nitrous oxide gas, and then the
chamber is turned to permit of gradually increasing doses of ether vapour.
ɔn as symptoms of nitrous oxide narcosis present (twitching of muscles,
lar stertor, etc.), the gas-bag is detached and the ordinary ether-bag
ıuted.

Ormsby's mask does not permit of this gradual addition of ether vapour;
trous oxide anæsthesia must be induced with the ordinary apparatus, and
rapid change is made to the fully-charged ether inhaler. The results are
ently satisfactory, but much more experience and skill are required than
the Clover apparatus is used.

advantages claimed for this 'combined method' are that anæsthesia is
:d much more rapidly (two minutes), and, what is far more important,
ocess is much less unpleasant for the patient than when ether alone is
yed. The patient is apt, especially when the Ormsby's mask is used, to
ıe rather livid and rigid, but these conditions pass off in the course of a
: or two.

o obviate the depressing effects of chloroform, a combination known as
C.E. Mixture is often used, consisting of alcohol, chloroform, and ether,
d in the proportion of one, two and three parts respectively. It may be
either from a Rendel's mask, or by the open method as for chloroform,
e latter plan is only applicable to children and weakly individuals, who
: but little anæsthetic. *Rendel's mask* consists of an oval box open at one
ıd shaped to fit the nose and mouth, and the fundus perforated with holes
nit of the free entrance of air; it may be made of leather, or preferably of
id or metal. Two or three sponges are placed within it, and soaked with
æsthetic, the patient breathing in and out of the cone. The inspired air is
den with the vapour, and the amount admitted is regulated in measure by
ıg a certain proportion of the inlet holes with the hand. The objection to
ıgent is that it evaporates somewhat unequally, the ether coming off first,
ıving an excess of chloroform, which when administered in a cone may
ıgerous; this can, however, be obviated by remoistening the sponges
tely with the mixture and with pure ether.

uring recent years **ethyl chloride** has been introduced as a general
etic with excellent results. It may be used (*a*) for short operations on
uth or nose—*e.g.*, tooth-extraction or removal of adenoids, where a single
ı sufficient for the purpose; (*b*) for minor operations elsewhere—*e.g.*,
g abscesses, reducing fractures and dislocations; and (*c*) for inducing
esia, which can be maintained by ether, in prolonged operations. Its
s limited by its extremely volatile nature and by the method which must

be employed in its administration. For this purpose an Ormsby's mask is utilized; 2 or 3 c.c. are poured on the sponge, and the apparatus is firmly placed over the patient's mouth. Anæsthesia is quickly induced without struggling or suffocative effects, and after the operation is over the patient rapidly regains consciousness, and rarely suffers from unpleasant after-effects. A combination of this agent, known as **Somnoform**, has been a good deal exploited, but there is no advantage in its employment; it is probably less pleasant to take, and leaves more marked after-effects.

General Remarks as to the Administration of Anæsthetics.

The medical practitioner must never lose sight of the fact that a certain element of risk is necessarily attached to the artificial induction of a condition in which the activity of the nervous system is entirely suspended, except for the maintenance of those phenomena which are actually essential for life. Hence, an anæsthetic should never be given, unless absolutely necessary, without careful preparation of the patient, or such examination as shall satisfy the doctor as to his capability of safely taking it.

The **Preparation of the Patient** is a most important proceeding. When practicable, the general habits of the individual should be carefully regulated for a few days prior to the operation, and on the preceding night a suitable purgative is administered, castor-oil being perhaps the most efficacious. Any food given on the morning of the operation should be light and easily assimilable, whilst nothing should be taken for at least three hours previously, so as to make sure that the stomach is empty. In casualty cases, it may be advisable to relieve gastric distension with an emetic, or by washing out the organ before commencing the administration. The anæsthetist must ascertain that no loose artificial teeth are present in the mouth, and that no tight clothes or bands encircle the neck or thorax. In very nervous cases, or where much shock is anticipated, a preliminary hypodermic injection of strychnine or a nutrient enema may be administered.

The anæsthetic should never be pushed in the early stages, but is given slowly and gradually, especially in nervous individuals. When there is any struggling, the movements of the limbs should be restrained with as little force as possible, and care must be taken during the deep respirations which follow such struggling not to administer an overdose. The condition which the administrator should aim at maintaining is one characterized by total muscular relaxation, insensitiveness of the cornea, and a contracted state of the pupil, whilst the pulse and breathing continue regular. If the pupil commences to dilate, and the corneal reflex is present, the patient is apt to move when the knife is used, indicating that more anæsthetic is required. Dilatation of the pupil with an insensitive cornea is always an indication for suspending the administration for a time. If the anæsthesia is not sufficiently deep, vomiting is likely to occur, being ushered in by weakness and rapidity of the pulse, and pallor of the face; this may often be averted by pushing the anæsthetic. The anæsthetist's chief attention must be directed to observing the state of the respiration and pupil; but he should also note the colour of the lips, cheeks, and ears, as thereby valuable information is gained as to the condition of the circulation. The pulse should be felt occasionally, but it is less important to attend to this than to the other points noted above. After the deep anæsthesia required in division of the skin, most operative proceedings on the subcutaneous tissues are comparatively painless, and hence the anæsthetic need not be pushed quite so far. Whilst the wound is being closed, the patient must be again somewhat more completely under control. In operations upon the mouth associated with hæmorrhage, the head must be occasionally turned to one side to allow the blood to gravitate out of the mouth, and the pharynx well sponged, so as to prevent the admission of clot and other matters into the air-passages. It is also a valuable routine plan to insist upon the head always being turned on one side, especially when ether is being given, since mucus tends to collect about the pharynx.

The **After-Treatment** of the patient is always a matter of considerable im-

ce. He is carried from the table and placed on his back, or preferably, possible, on his right side, in bed with the head low. When there is any cy to shock, hot-water bottles, well wrapped up, should be applied to the id sides, and hot blankets over all. Absolute quiet must be enjoined for hours, and the room darkened, so that, if possible, the patient may fall . No food is administered for at least three or four hours, and then only autiously, a little weak tea, soda-water, or beef-tea being given. The : is likely to vomit on returning from unconsciousness, perhaps bringing ttle bile-stained mucus, but if the anæsthetic has been judiciously given, ı ceases. Occasionally, however, the vomiting persists for some time, ing very troublesome. It may generally be checked by a hypodermic on of morphia, and by washing out the mouth with warm water ; but in evere cases, lasting for some days, the patient's nutrition may have to be ined by enemata, and the stomach kept absolutely at rest. Benefit may mes be derived by giving a little bismuth and hydrocyanic acid in an scing mixture, or perhaps champagne ; but, as a rule, all administration l by the mouth should be stopped until the vomiting has ceased.

e chief **Dangers** are encountered during the administration of anæsthetics : **structed Respiration** usually results from falling backwards of the root tongue, which blocks the entrance of air into the larynx. The respira- gradually become more and more stertorous, the face and ears become and, if the condition is not relieved, the chest continues to heave without entering or leaving it, and finally ceases when the patient is completely iated. The early stages of this condition are of common occurrence, er the anæsthetic, and the administrator must always be on the look-out deavour to prevent it by turning the head or the patient himself so that gue falls to one side. If it occurs in spite of this position being adopted, ninistration is at once suspended, whilst the tongue must at all hazards be forwards. This may be accomplished in the early stages by pulling on ard or chin, or by pressing the mandible forwards by the fingers placed the angle of the jaw. In the later stages the mouth should be forcibly l by a gag, and the tongue grasped by forceps and pulled well forwards, ger may be passed back into the pharynx to draw the root and epiglottis ds, and at the same time ascertain that the entrance to the glottis is free bstruction. Artificial respiration should be undertaken if the breathing has y stopped. Death should never result from this cause, and if it occurs, it ly be attributed to the carelessness of the anæsthetist.

ruction to the respiration may occasionally arise from the entrance of d material into the air-passages or lungs, the patient becoming cyanosed an attack of vomiting, and passing rapidly into a state of asphyxia. In case the finger must be swept around the pharynx, if the mouth can be l, to see that the glottis is clear, whilst tracheotomy or laryngotomy may essary should the teeth be firmly clenched, or if the obstruction is below rance to the glottis. Fortunately, this accident is of rare occurrence.

mplete Cessation of Respiration is the usual primary phenomenon from rdose of chloroform ; it is also stated to happen occasionally during ether is. The pulse continues to beat distinctly for a few seconds, although tory movements have ceased. Treatment consists in at once stopping the istration, whilst the tongue is drawn forwards, and the fauces cleared by ger. The head should be lowered over the end of the table, and young n may even be completely inverted, so as to induce a flow of blood to the Artificial respiration is commenced without delay, whilst the thoracic s may be flicked with a cold wet towel, or alternately douched with hot ld water. Strychnine or ether should also be injected hypodermically, the condition persists and the heart's action ceases, a Faradic current may sed from the second or third intercostal space in front to an electrode over the spine. Attempts at resuscitation should be continued for half to quarters of an hour. At the same time, these measures must be undertaken iscretion, as otherwise it is quite possible to extinguish the feeble spark of the very means which, used wisely, would have restored it.

eath occasionally results from primary **Cardiac Failure**, which may arise

(*a*) from fright during the administration of the anæsthetic ; (*b*) from shock with cardiac inhibition, by commencing the operation before complete anæsthesia has been obtained ; and (*c*) from an overdose of chloroform or ether acting directly on the nerve centres or on the muscular substance of the heart. On *post-mortem* examination in such cases, the heart muscle is found to be thin and flabby, and perhaps infiltrated with fat ; the ventricular walls are especially affected. Unfortunately, this condition cannot be recognised with certainty by the stethoscope. Patients with simple valvular lesions, where the defect has been more or less compensated, do not generally run any extra risk. The treatment to be adopted in cases of cardiac failure during anæsthesia is the same as for stoppage of the respiration.

The **Choice of an Anæsthetic** in any particular case depends mainly on the condition of the circulatory and respiratory apparatus of the patient. Ether is perhaps, on the whole, the safest agent to employ, especially in adults, although it is less pleasant to take ; it may cause a good deal of bronchial irritation and congestion, and is more likely to give rise to troublesome after-vomiting, although such does not usually last long. It is sometimes followed by unpleasant delirium. Chloroform is easier to administer, more pleasant to take, and less likely to lead to objectionable after-effects. It is the best anæsthetic for young children and old people, though its action upon the heart contra-indicates its use in patients whose circulation is weak. The A.C.E. mixture may also be safely employed, if the precautions already indicated on an earlier page are attended to.

Ether is certainly contra-indicated in patients suffering from any bronchitic or pulmonary trouble, and its administration for operations about the face or mouth is, of course, impracticable. Chloroform should not be given in cases of cardiac weakness or advanced renal disease ; for abdominal work it is always to be preferred to any other agent, as also in operations on the brain.

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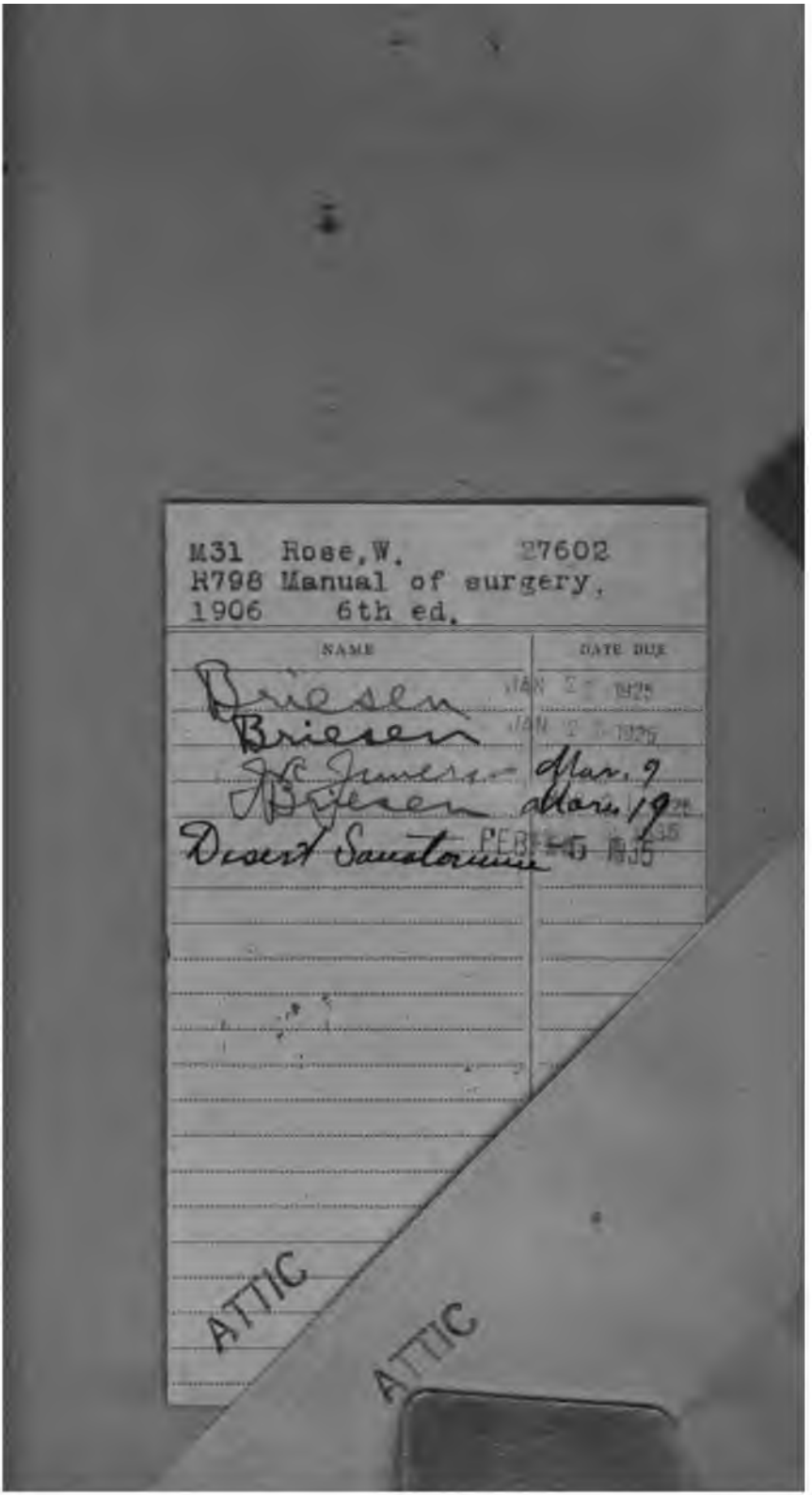
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